Consulting Engineer

Photo by Fabian Bachrach

July 1961

MASON G LOCKWOOD, president of Lockwood, Andrews and Newnam Inc., Houston, believes in concerted action by consulting engineers who are losing ground steadily to government engineers. Lockwood, principal author of the Coordinating Committee (ASCE, ARBA, CEC) policy paper on government engineering, was quoted in the Congressional Record: "The consulting engineer does not belong on the defensive in this situation. . . To any who know the facts—and I believe almost every thinking engineer does, whether in public or private practice— to base this pitch (for more government staff design) on reasons of economy is a monstrous and maddening outrage.

Continued on page 12

MISSILE SILO EXCAVATION

Stabilized by Halliburton Pressure Grouting!

THIS MISSILE LAUNCHING SITE, a hard-type underground Silo installation, is located in an area plagued by a deep crust of unconsolidated gravel and sand. Facing the problem of excavating a vertical wall for this site, the contractor called upon Halliburton Company for Pressure Grouting Service to help consolidate the loose soil. After 51 grouting holes were drilled around the perimeter of the site and the pipe was cemented, Halliburton placed its revolutionary new **HERCULOX** grouting fluid into the formation, stabilizing the loose gravel and sand. By perforating the pipe with Halliburton's jet shaped-charges, the grouting chemical was selectively placed opposite the offending formation.

HERCULOX is a permanent, hard setting water-base resin material, chemically unmatched for its strength and economy. The near-water viscosity of **HERCULOX** allows it to penetrate even fine unconsolidated and some consolidated sands *at low pumping pressures!*

HERCULOX can be custom-tailored to specific temperature and depth requirements. It sets satisfactorily at temperatures as low as 65°F., building to a 1,500 psi compressive strength *in a matter of only a few hours.* In applications such as running water shut-off, **HERCULOX** may be accelerated for even faster setting time.

IN ADDITION TO **HERCULOX**, Halliburton provides other chemical grouting fluids, including HYDRO-LOK (PWG), HYDRO-LOK (HG-10), and BLOX-ALL . . . each designed to perform specific jobs depending upon underground conditions encountered in the advancing technology of pressure grouting.

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HALLIBURTON IS FINANCIALLY ABLE TO PERFORM ANY SIZE GROUTING JOB AS A PRIME OR SUB-CONTRACTOR.

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800 KW!

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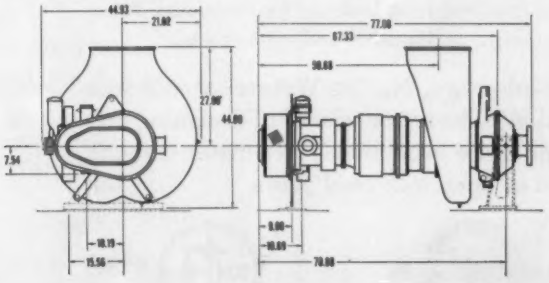
Versatile, compact industrial generator sets powered by Solar's T-1000 gas turbine engine have a nominal rating of 800 kw. They are ideal for either peak loading or constant duty electrical power applications. Simple design and rugged construction reduces maintenance



to a minimum. Installation is extremely simple. The engine is about 1/10th as heavy as diesel units of similar horsepower and occupies only 51 cu ft. No elaborate foundation or flooring base is required because the gas turbine is practically vibration-free.

Equipped with one of the several control systems available, the engine can be operated remotely and entirely automatically. It starts instantly and operates at full load without warmup, even after long periods of standby service.

Fuel economy of the Solar T-1000 engine is unmatched in its field. The engine runs equally well on a variety of fuels including gasoline, diesel fuel and natural gas. The exhaust may be used in a waste heat boiler or as combustion air in process apparatus or conventional boilers.

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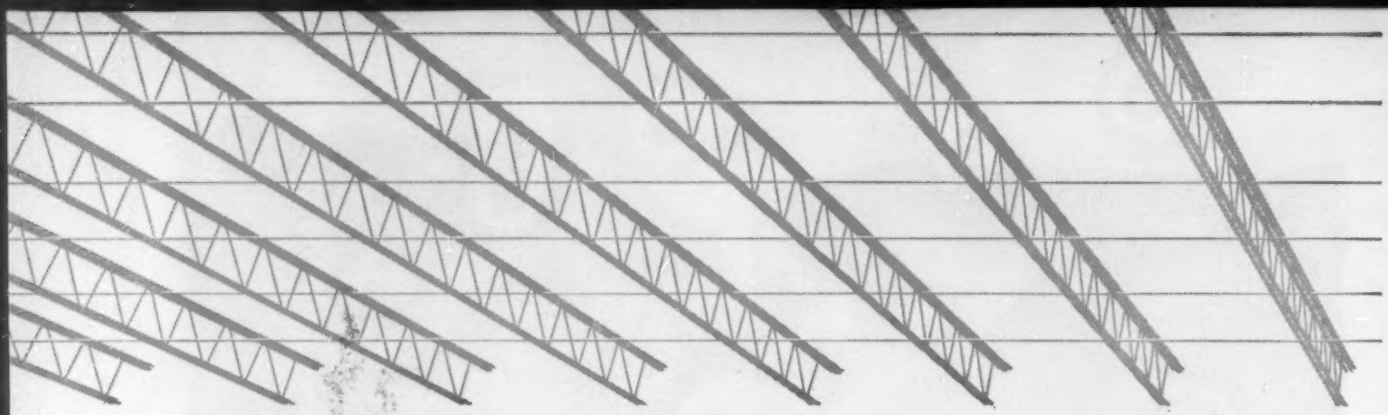

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BPA

CONSULTING ENGINEER is published monthly by R. W. Roe and Partners at 217 Wayne Street, Saint Joseph, Michigan. Price 1 year $10.00; foreign $15.00; single copy $1.00. Accepted as Controlled Circulation Publication at Saint Joseph, Michigan.

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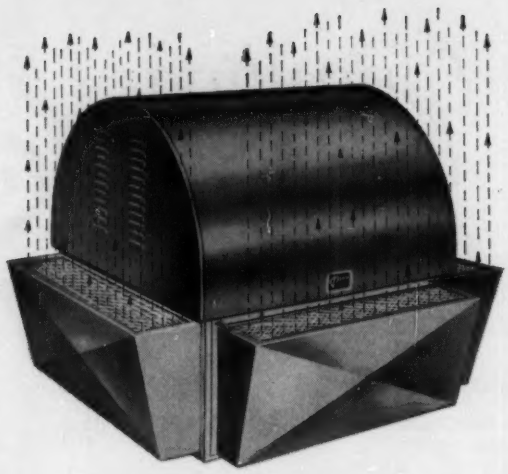

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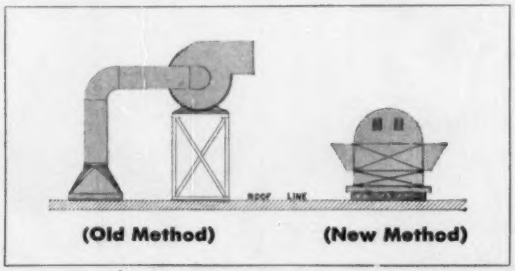

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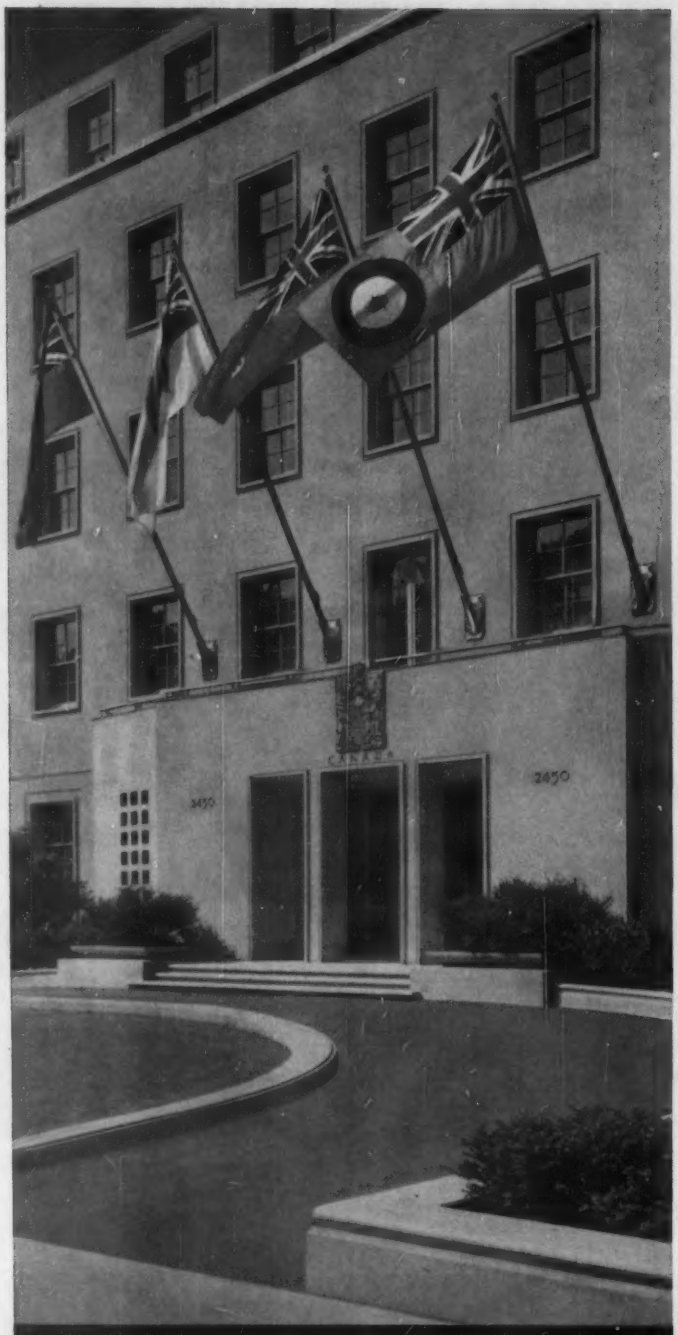

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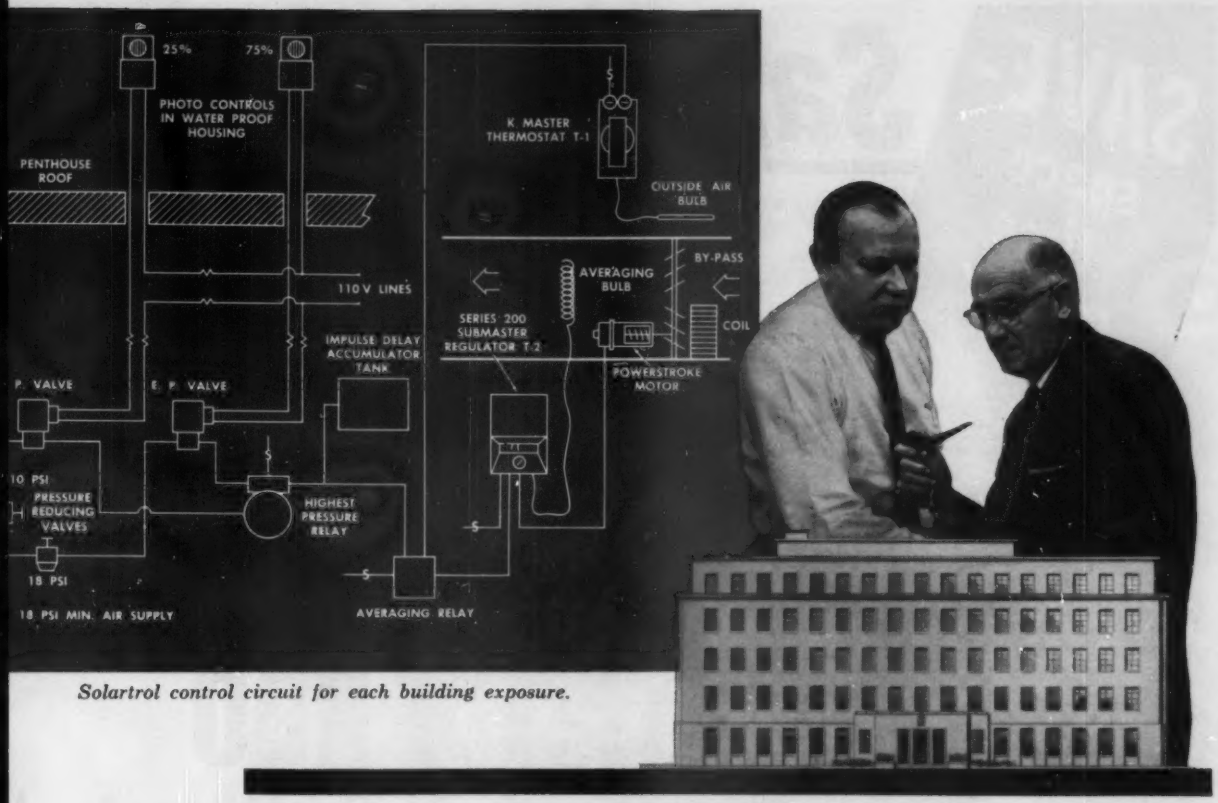
Consulting Engineer, Charles S. Leopold, confirmed his reputation for imaginative engineering when he put the sun to work in the air conditioning system of the Canadian Joint Staff Building, Washington, D. C. As a result, the occupants enjoy year-round comfort.

The Powers SOLARTOL, an electronic-pneumatic system designed to measure solar intensity and regulate air conditioning systems accordingly, is used to accomplish this.



Solartrol control circuit for each building exposure.

G. Titus Fenn, chief designer, and Charles S. Leopold.

HOW IT WORKS—Four pairs of photo-electric cells are mounted on the roof, each pair measuring the solar radiation falling on one side of the building which is oriented 45° from the true north-south. They are connected to submaster thermostats that control conditioned air temperature for each exterior zone in the building. One cell of each pair is set to operate at 25% Solar Gain and the other at 75%.

With no sunlight, an outdoor-air master-thermostat regulates the conditioned air temperature. As outside temperature rises from 78° to 95°, the zone air supply controls reset through a range of 68° to 63°.

With 50% Solar Intensity, the thermostat controls for that particular building zone are adjusted to operate at a 5° lower temperature range — 63° to 58° — to compensate for the additional heat of the sun.

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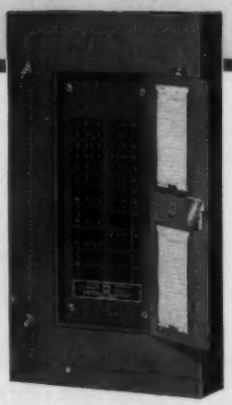

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- **Distributed phase bussing**—reads like a wiring diagram. Two and three-pole breakers may be mounted anywhere in the panelboard.
- **Plenty of wiring room.** 5" end gutters with 100 and 225 ampere mains; 8" end gutters with 400 and 600 ampere mains.
- **Main lugs approved** for aluminum or copper wire—both main breaker and main lugs.
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- **Trip indication** tells instantly whether circuit has been turned off intentionally or has "tripped."
- **Temperature-compensated**—prevents nuisance tripping.
- **Common trip** prevents single phasing or personal injury.
- **Single handles** on two and three-pole breakers for modern, streamlined appearance.
- **Plated jaws and connectors** assure positive connections.
- **Heavy duty industrial quality** for long life and trouble-free operation.

***Write* for the complete story**
Address Square D Company, 1601 Mercer Road, Lexington, Kentucky

wherever electricity is distributed and controlled

MASON G. LOCKWOOD

– Starts on front cover

"Consultants never have, to any significant degree, either done or advocated that they do the engineering which public agencies can do better or more economically. They have no right whatever to such work.

"It is a well established and historical fact that government is a ratcheted, unilateral device which, until it collapses, can move in only one direction. It is as incompressible as water, but as expansible as hydrogen. I should like to emphasize that it is my belief that the trend in this direction is as strong in many state governments and in many municipalities and other local governmental agencies as it is at the noisier and more publicized Federal level. I do not think it is being too extreme to say that this could be the beginning of a war for our economic survival."

Lockwood, who was the 88th president of the American Society of Civil Engineers (the only one from Texas and probably the only one with a degree in electrical engineering), also advocates that engineers take an active part in both social and community activities – and he practices what he preaches.

Currently he is vice president of the engineering division of the American Road Builders' Association, the organization primarily responsible for the formation of the Coordinating Committee. He also is active on ASCE committees and is a past president of the Texas Society of Professional Engineers and the Houston Chamber of Commerce (currently chairman of the latter's task committee for industrial development).

One of two ASCE representatives on the Coordinating Committee, Lockwood explained that the policy paper on government engineering is not written as strongly in favor of consultants as some perhaps would like. However, the policy was written so that it could be endorsed by all engineers. Of course, it did not quite work out that way. ASCE declined endorsement on the basis that it already had such a policy.

In his endorsement of the use of consulting engineers on government projects, Lockwood has stressed that no reputable engineering group has any idea of protecting those who have not met the highest professional standards. And any group – including the consulting engineering profession – has its slightly spotty apples. "In his appointment of human character, God has played no professional favorites."

Civil Engineer . . . the Hard Way

A second generation Texan and the son of a rancher, Lockwood spent his early childhood in Taylor, Texas. While in grammar school, he got his first job working as a waterboy for a contractor building a local "skyscraper" – a four-story hotel.

"The coffee break has been developed to a fine art in Texas. But this contractor had a different approach. Since the work day was 6 a.m. to 6 p.m., the afternoon productivity went down as the temperature went up. When the men began to slow down, it was my job to fill the water buckets with beer at the next door saloon. About half an hour later the men not only would be working faster, they would be singing."

The superintendent on this project was a graduate civil engineer. Watching him work and talking with him convinced young Lockwood that he wanted to become a civil engineer too.

After graduating from high school in Collinsville, Texas, Lockwood entered Austin College, at Sherman. "I had been Valedictorian of my high school class," he recalled. "Of course, there were only four in the class, and three of us just about tied for the honor."

After nearly four years in Austin College, Lockwood taught in a country school for two years, saving his money to study engineering. "Then, when I matriculated at Rice Institute (now Rice University), I learned that it would take me three years to graduate in civil engineering but only two in electrical. Conflicts in some of civil's required academic courses caused the trouble. While still in a state of shock I signed up for electrical."

In 1927, after graduation, Lockwood got a job as a laborer with the Houston Lighting and Power Company. Soon he was a foreman, and later was loaned to a construction affiliate as assistant electrical superintendent on power plant construction. Next, he was back at HL&PC working on industrial problems and engineering and economic reports. "Fortunately, most of my experience in these earlier years was in the civil field – the area of my abiding interest."

Private Practice

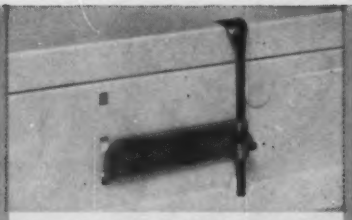
Lockwood and two other engineers at the utility firm – J. R. Dowdell (electrical) and William M. Andrews (mechanical) – formed their own firm in 1935. "Dowdell, Lockwood & Andrews managed to ride out that last year of the depression by blind good fortune." However, the young firm did have one major sustaining client, Burrus Mills, of Dallas. And the firm still has this first client.

During the years, the firm has designed and supervised construction of large grain elevators, bulk storage warehouses, and various flour mill and grain-handling facilities for Burrus and others.

Just prior to America's entry in World War II, Lockwood & Andrews (Dowdell left the firm after a year and established a very successful equipment business) got one of its most unusual projects, in association with David M. Duller, another consultant.

Given a one-page memo on facilities needed, a contract for design and supervision, and a selected cost-plus-fixed-fee contracting organization to work with, Lockwood & Andrews was commissioned to handle the $15 million San Jacinto Ordnance Depot and

GUTH saves up to 50% on Troffer installation*



Swing Mounting Bracket is preset for height of ceiling support members by adjusting single screw.

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Adjust screw to draw up troffer trim flush with ceiling. The job is done!

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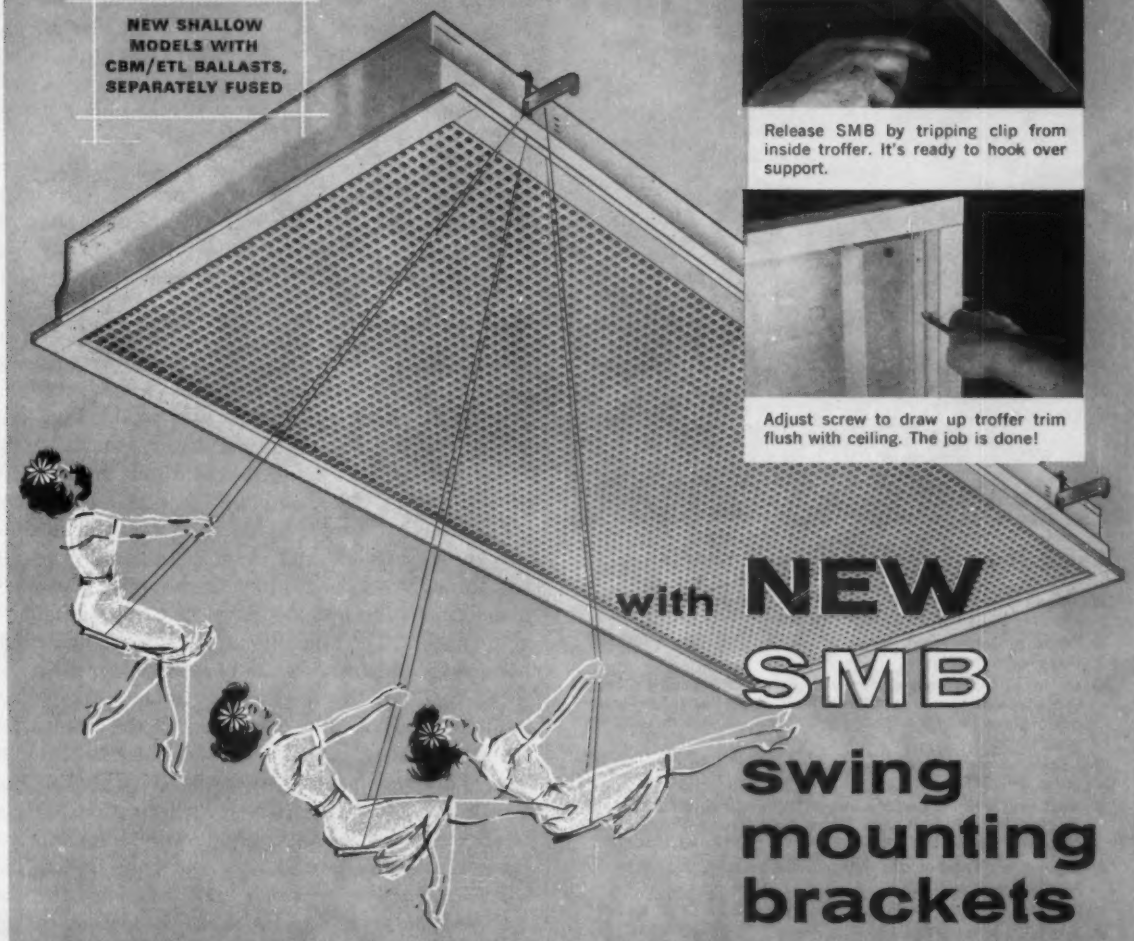

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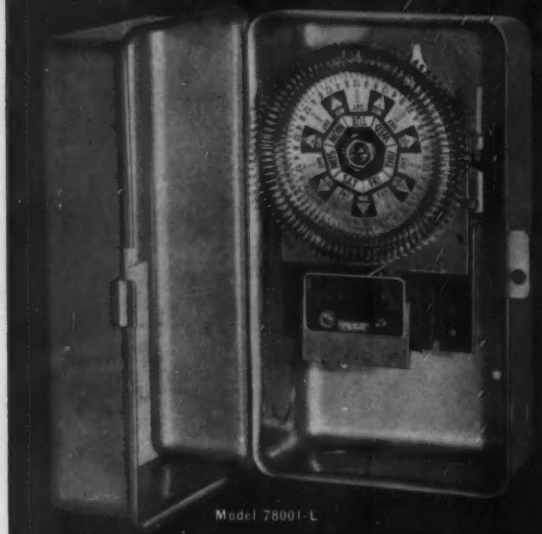

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Shipping Terminal, near Houston. "We were given about two weeks lead time for planning and some 16 months for construction. The contract required that a partner – in this case me – spend full time on the job. This was all permanent construction. Despite one of the wettest construction seasons in Houston history and a major tropical hurricane, our team managed to finish on schedule."

The war years were spent in design and supervision of industrial installations and military projects. Lockwood & Andrews, occasionally in association with other consulting firms, handled several complete new military airfields and many other facilities, such as runways, buildings, and fueling systems for the Army, Navy, and Air Force.

Shortly after the War, the firm became Lockwood, Andrews & Newnam when Frank H. Newnam Jr., a civil engineer with highway, soil mechanics, airport, and navigation experience joined the firm.

Andrews, for many years chairman of the Texas registration board, died last year at age 50. "His tragic death," says Lockwood, "was a staggering shock to me. We spent 25 years as partners, and our personal and professional relationships were absolutely ideal."

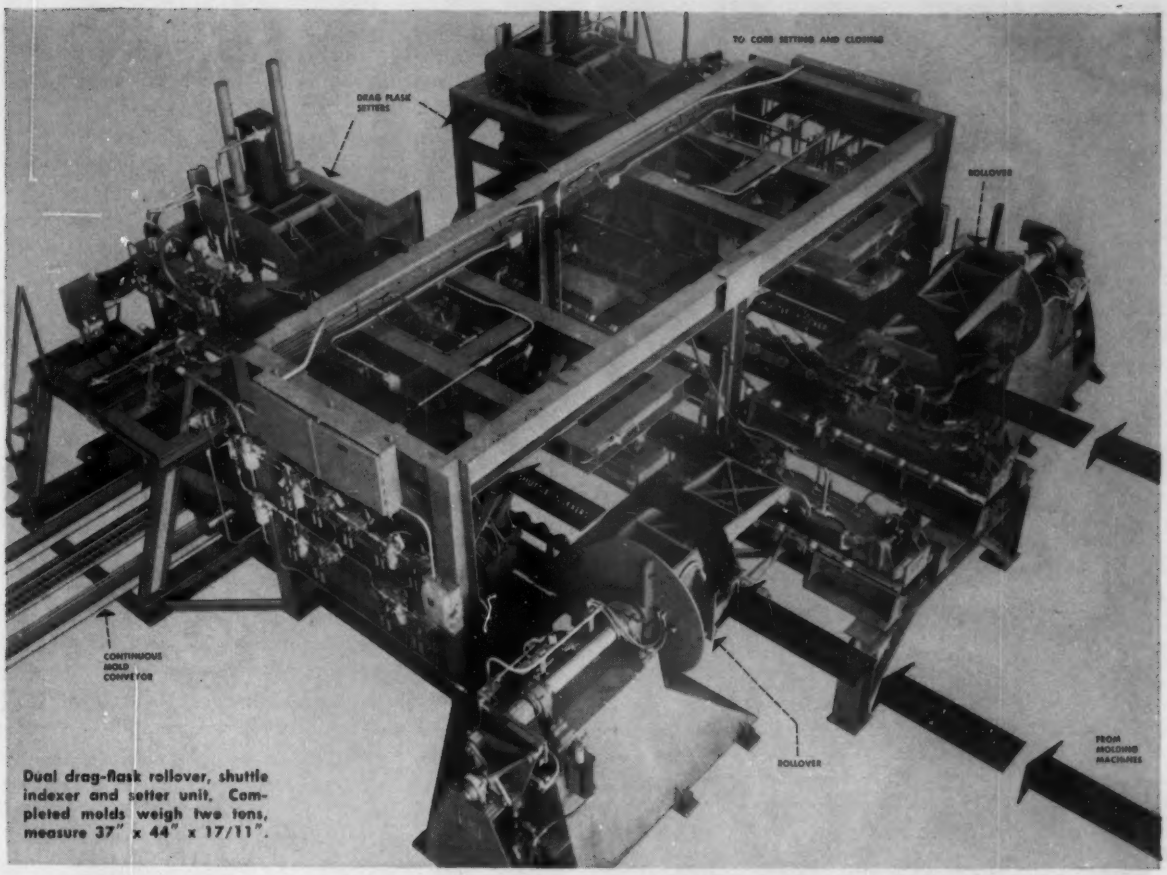
How to Get Water

In 1952, Dallas was faced with the most severe drought in its history. It had only a 120-day water supply on hand when Lockwood's firm was retained as consultant to solve the problem. "The responsibility involved was frightening. The welfare of half-a-million people was at stake, and time was at a premium."

Lockwood stresses that Dallas got into that situation through an unusual chain of circumstances and not through negligence. Water supplies had been planned on historical low flows, but this drought rewrote history. The available supply in Lake Dallas had been overestimated because of accumulating silt.

"Three alternatives evolved. A temporary dam could be built quickly on the West Fork of the Trinity, but we knew this idea would be unpopular because the West Fork was heavily laced with sewage from Fort Worth and would require heavy chlorination. We also could pump highly mineralized water from the Red River over a divide and flow it into Lake Dallas. This would take nine months on a crash basis, and the mineral content of the water made it impractical for more than temporary use. The third alternative was drilling more wells, which might temporarily help Dallas but would lower an already dangerously low water table to the extent that it would have worked a hardship on many small municipalities in the area.

"These possible solutions proved to be largely a confirmation of the conclusions of Forrest & Cotton, the City's regular consultants. Finally, we recommended that – without delay – Dallas construct a temporary dam on the Trinity and also begin con-



Dual drag-flask rollover, shuttle indexer and setter unit. Completed molds weigh two tons, measure 37" x 44" x 17/11".

Planet system automatically removes and positions 250 one-ton flasks an hour on moving conveyor

To design a system that will strip and close flasks automatically on a continuously moving conveyor has always been a perplexing problem. But Planet Corporation solved this problem for one of the automotive industry's largest foundries . . . and at the same time provided the key to increase productivity approximately 400%. In addition, this unusual system provides maximum casting flexibility and operational reliability.

Flask Handling System Operation . . .

Following molding, the drag flasks are fed into the dual drag-flask rollover, shuttle indexer and setter unit (see diagram). The flasks are rolled over 180°, then indexed to the unique in-flight setters which accurately positions them on the continuously moving car-top mold conveyor. From this point, they are moved through core setting to the dual cope-flask-closing unit. The cope-flask subsystem, from molding to closing, is similar to the drag-flask unit except rollovers are not required.

After pouring and cooling, the cope-flask-stripper unit lifts the cope flask off the drag. The drag flask continues on the mold conveyor to the drag "pick-off", or lifting, device. On their removal from the conveyor, the flasks are recirculated through the system. Both removal operations are performed while the mold conveyor moves as a constant speed.

This integrated materials handling system *increased productivity approximately 400% and resulted in substantial cost savings.*

Production Flexibility . . .

With this flask handling system, it is possible to produce either six-or four-cylinder blocks or both simultaneously. This feature provides this large automotive foundry with maximum casting flexibility . . . a maximum capacity of 500 blocks an hour.

Built-in Reliability . . .

Flasks handled by this system are controlled electrically and are locked at each position. They are parted or joined by lifting or lowering movements to eliminate damage to parting surfaces. The control system, which required more than 10 miles of wire and 600 relays, includes a feedback feature which allows pinpoint maintenance.

For additional operational reliability, this system was shop wired and piped, and shop tested.

An Example of Planet Versatility . . .

This is one example of Planet Versatility . . . Planet Corporation's ability to engineer, fabricate and install custom equipment that solve materials handling problems. Planet Versatility means you'll benefit from our diversified experience gained through service to leading corporations. It has paid them to plan with Planet . . . it will pay you, too! Write or call for complete information.

Sales Offices in Principal Cities in the United States and Mexico

PLANET CORPORATION
1832 SUNSET AVENUE
LANSING, MICHIGAN

- Engineered Handling Equipment
- Automation Equipment
- Mill & Foundry Equipment

SPECIFY
SUBMERSIBLE
Enpo
TRADE MARK
ENGINEERED POWER
ejector pumps
NON-CLOGGING
HEAVY DUTY
DEPENDABLE
check these outstanding Enpo features
ENPO heavy duty ejector pumps are extremely compact and engineered to operate completely submerged. Units are available in cast iron or cast bronze and feature a special non-clogging impeller for handling all types of waste; liquids, semi-solids and solids. Suggested applications are household, canning and packing plants, highway underpasses, etc. The pump only is available, or a complete ENPO package including pump, cast iron tank and switch can be specified. Both single and dual installations are shown below. Send for complete information.
HD IN FT.
200 Series
300 Series
5
6240
8400
10
4500
5880
15
2640
3600
20
720
1020
Approx. suitable this capacity for dual installations.
THE PIQUA MACHINE & MANUFACTURING COMPANY
PIQUA, OHIO

struction on a system to bring water from the Red River to the reservoir. Knowing the statistical chances of getting rain before either project was finished, it took real courage on the part of Dallas officials to authorize immediate construction. But they did."

Lockwood, Andrews & Newnam handles other types of public and private works: wharves and other waterfront facilities (master plans and wharves for the ports of Houston and Galveston, for example); roads and bridges; dams, power projects, and hydraulics; and especially industrial plants and buildings.

With a staff of approximately 75, in offices at Houston, Corpus Christi, and Victoria, the firm now bills $1 million annually in fees on quite diversified projects.

Business Structure and Personnel Policies

Formed as a partnership and operated as such until last January, Lockwood, Andrews & Newnam now is incorporated. "For many years I felt that consulting engineers should not incorporate for the same reasons attorneys do not. Professional people should be personally liable and responsible for their acts.

"However, I have undergone a change in philosophy. I no longer believe incorporation per se involves any question of professionalism. Since the War, the consulting engineer has become more of a business professional than a pure consultant. The tendency is for firms to expand, both in the number of employees and in work handled. Few consultants now are privileged to sit in ivory towers, turning out designs and reports in their own good time.

"But we incorporated, primarily, to assure continuity and afford more security to our employees. I think our engineers are entitled to at least as much security as are professionals in industry. We have never believed in an 'on again — off again' itinerant engineering staff.

"Taxes were not a major factor in our decision to incorporate. We do expect our Federal tax burden to be somewhat higher, but not significantly so."

Lockwood also believes strongly in a friendly and informal work atmosphere, with fairness to employees stressed. The firm has had a profit sharing arrangement for 20 years and a retirement plan has been in effect for 12 years. Division chiefs and department heads share profits on a fixed formula. All other employees, who have been with the firm for three years or more, get an annual bonus determined by the directors on the basis of the year's profits.

"Long ago, we solved the coffee break problem. I think we were one of the first consulting firms in the country to install coffee bars in our offices and serve free coffee. This system is a highly satisfactory built-in feature of each of our offices, which are owned by the firm and designed for its exclusive occupancy."

Lockwood's firm also pays time-and-a-half. "We decided years ago it was unfair, regardless of salary, to

University Apartments, Chicago, Ill. Owner: Webb & Knapp, Inc. Architect: I. M. Pei and Associates. General Contractor: Taylor Construction Co.

Big. New. Crane-equipped. Chicago's spectacular University Apartments feature Crane fixtures in every kitchen and bath

Fabulous setting for gracious living in the heart of bustling Chicago . . . the glamorous new University Apartments. So modern, a closed circuit TV intercom system is included in each of the 540 apartments. And Crane provides the ultimate touch of luxury and convenience in every kitchen and bath.

Gleaming double-basin kitchen sinks with sweeping contemporary lines. Bathtubs, closets, lavatories with the clean modern styling that blends so beautifully with today's most advanced architectural designs. A total of more than 2,800 fixtures—all made with Crane's flair for precision that goes far beyond ordinary standards.

Crane offers one of the largest selections of handsomely styled plumbing fixtures and fittings on the market today. For homes, apartments, commercial, industrial or institutional building—Crane equipment is always available in the color, style, size and price you want. In heating and air conditioning equipment, too, Crane gives you the same wide choice, the same high quality, the same precision manufacture. For complete details, consult your regular contractor or your Crane representative. Or write direct to Crane Co., Plumbing-Heating-Air Conditioning Group, Box 780, Johnstown, Pennsylvania.

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HEART
OF HOME AND
INDUSTRY

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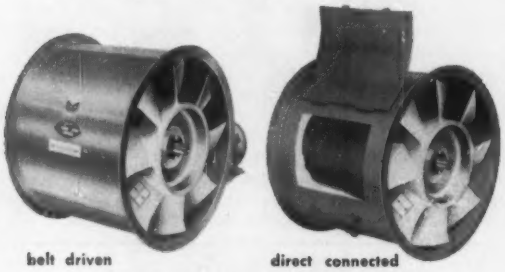
ELECTRONIC CONTROLS
PLUMBING
HEATING • AIR CONDITIONING

high speed - high efficiency

Aerovent's new Tubeaxial Fan, designed around a new 8-blade "Macheta" Airfoil Axial Flow Propeller, offers top performance against medium pressures at speeds to 3450 RPM. Available in 16", 18", 24", and 30" diameters, this unit combines speed, stamina and modern functional design. Easily installed in present ductwork or engineered to new construction, it's the right answer for resistances to 4" SP. Another outstanding development from Aerovent—America's finest industrial fans and air equipment.



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Air deliveries of Aerovent equipment determined in accordance with established and accepted codes and guaranteed by manufacturer.

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Aerovent FANS *Aerovent*

FAN COMPANY, INC.

ASH AND BACON STREETS PIQUA, OHIO

expect people to work overtime without extra pay. Even our supervisory personnel get salary plus 20 percent if they work late."

The Human Touch

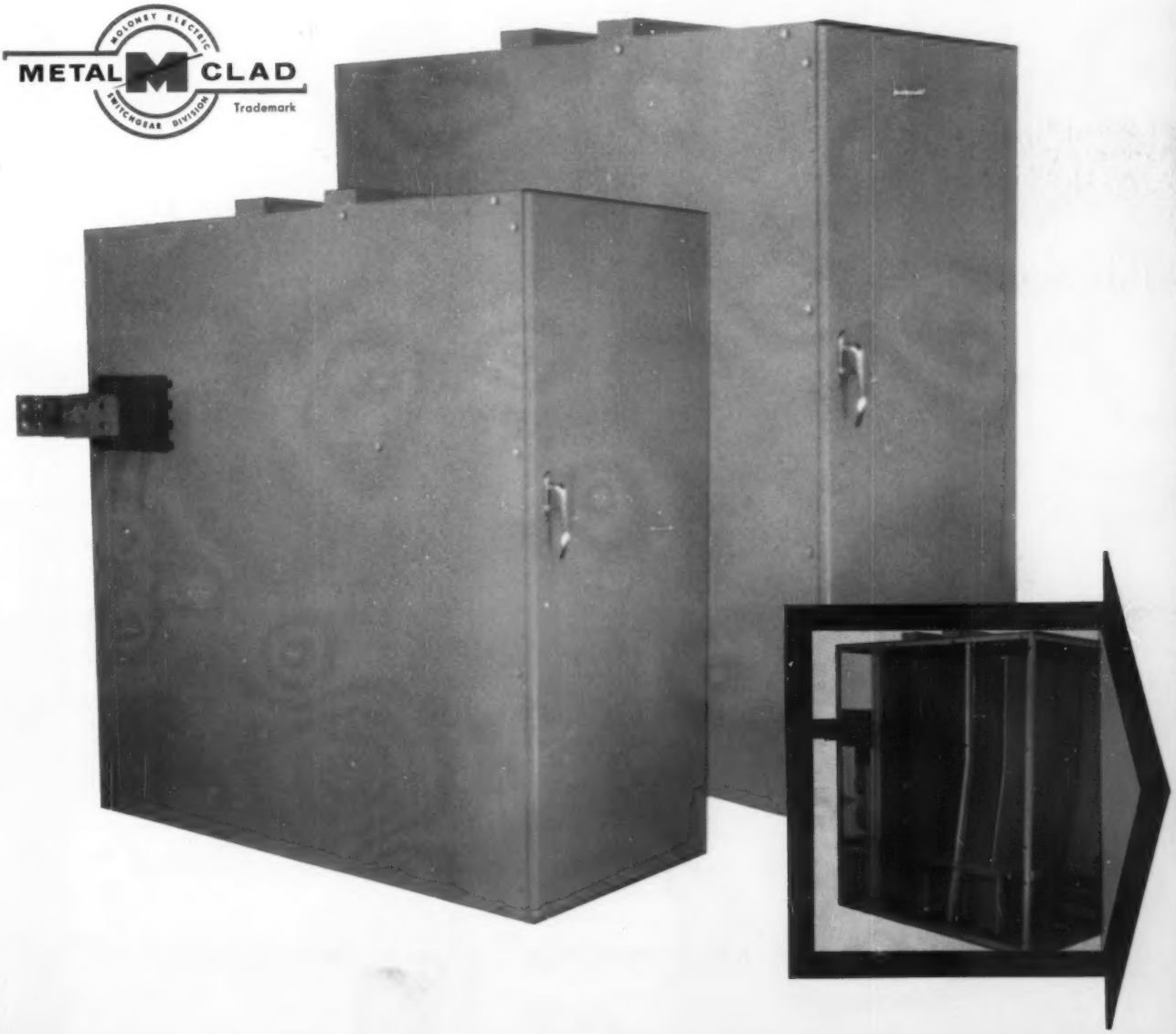
Outspoken and with a sense of humor, Lockwood has interesting views on a wide range of subjects.
¶ *Education* — "I am quite prepared to believe that any student engineer who is superior in vocabulary, logic, and imagination — whether because of exceptional natural endowments, acquired knowledge, or both — can be a successful practicing engineer."
¶ *Public Relations* — "I belong to the old school that thinks an engineer should not advertise. But I believe it quite proper and certainly businesslike for a consulting firm not to resist favorable and dignified news stories about the firm. Moreover, I think it good sense for a consultant to avail himself of professional public relations counsel, if he can find a firm that can be effective under the restraints of professional ethics and good taste for engineers."
¶ *Professional, Civic Activities* — "It is trite indeed to say that busy people are useful people or happy people. But no one can deny this truth. Sometimes we confuse a frantic person with a busy person, and there is a great difference. But on the whole, nothing seems to satisfy man's inner longings so much as success in professional or civic activities."
¶ *Dishonesty in Government, Public Projects* — "Criminality and complacency are highly compatible. We must get rid of one before we can eliminate the other. Certainly the events of recent years should convince us that, by working toward active and authoritative control measures, business would not be meddling in something which does not concern it."
¶ *Soil Mechanics* — "It seems to me that it is time to begin debunking the false mysticism which has built up around [soil mechanics] during these 30 years. Otherwise, young engineers who have not majored in soil mechanics are going to continue giving up on it before they start, as are those more mature practitioners who are approaching, or have already reached, the you-can't-teach-an-old-dog-new-tricks age."
¶ *Engineers* — "It is an absurd and maddening anomaly that engineering, of all the professions, is the least self-assured. This, even as a growing pain, is altogether unwarranted. The assured professional manner is a studied, admirable, and invaluable hallmark of physicians, lawyers, clergymen, and even architects, our own closest associates in the design profession.

"Though we have every reason to exude an air of competence, our modesty — natural or false — is always showing too much. We are in command of the situation, but our demeanor belies it. As individuals and as a profession, we could use some of the classic confidence of the Texas Ranger who came alone because he understood there was only one riot." ▲▲

Now... Metal-Clad Switchgear from MOLONEY

After Several Years Of Intensive Research, Moloney Introduces Its 5 And 15 KV Metal-Clad Switchgear Line To Meet The Needs, And To Minimize Problems In The Field. Smallest, Most Compact In The Industry . . . Easy To Install And Maintain. Creative Break-Throughs In Design, Material Application And Manufacturing Techniques Result In Outstanding Performance, Substantial Savings.

METAL M CLAD
Trademark

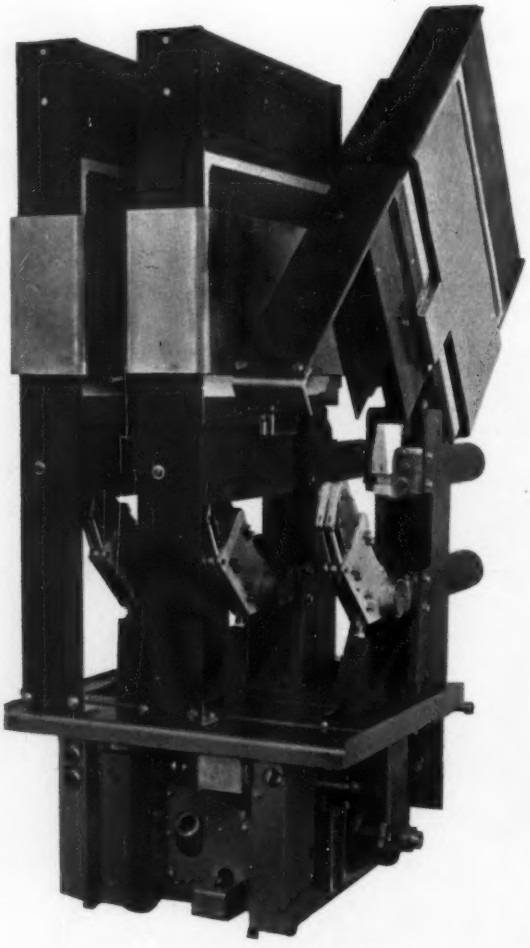


5 and 15 KV Production Units of Moloney Metal-Clad Switchgear Pass All Tests Successfully . . . Certifying High Efficiency Performance*

Moloney's decision to enter the switchgear field posed a formidable task: to formulate a creative, new approach to design and manufacture in addition to amplifying the desirable characteristics of switchgear previously available. These objectives dictated break-throughs in design, material application and manufacturing techniques . . . a fresh concept.

METAL M CLAD
Trademark

5 KV, 75 MVA, 1200 Amp.



15 KV, 500 MVA, 1200 Amp.

Moloney Metal-Clad Switchgear available for indoor or outdoor application, in all standard breaker ratings.

***KEMA Interrupting Test data available on request.**

Benefits of Moloney Metal-Clad Switchgear:

- **Superior circuit protection performance.**
- **Efficient use of all materials, resulting in economic benefit to the customer.**
- **Specialists, available to the industry, whose sole purpose is to help in the solution of circuit protection problems.**
- **Broadens your field of selection.**

The electrical industry has known the Moloney tradition of excellence for almost three quarters of a century. The same high standards . . . the same *"tradition of excellence"* is embodied in Moloney Metal-Clad Switchgear.

Exclusive and Distinctive Features

Moloney Designed and Developed*

COMPACT SIZE—NEMA Standard Moloney 5 and 15 KV Metal-Clad Switchgear requires smallest installation space. Typical 5 KV cubicle is 26" wide, 58" deep and 63" high. Typical 15 KV cubicle is 36" wide, 85" deep and 75" high.

EXCLUSIVE CONTACT DESIGN—Extremely high blow-on forces are obtained on *both* the arcing and main contacts. Arcing contact blow-on results from the geometry of design. Main contact blow-on is attained by means of a slotted block between the primary conductor and the stationary contacts which directs current flow in a loop. This results in solid contact pressure . . . lengthening contact life.

EXCLUSIVE PUFFER LOCATION—Hollow primary conductors permit location of puffer close to source of arc. Glass polyester puffer nozzle is stationary . . . directs blast of air toward arc the moment contacts part.

EXCLUSIVE PRIMARY CONDUCTOR INNERCOOLING—Innercooling results from hollow primary conductors which allow continuous circulation of air for best cooling of main current carrying components.

EXCLUSIVE BLOW-OUT COIL DESIGN—High dielectric strength, compound-face wound, cast in place, blow-out coils assure efficient arc interruption over full current range.

DUAL ARC INTERRUPTION—Series interruption arrangement splits arc for best arc control.

BREAKER MOUNTED AUXILIARY CONTROLS—Conveniently located on breaker frame. No separate testing controls are needed. Trip mechanism is located perpendicular to direction of shock, preventing erratic tripping. Dual breaker safety interlocks provide maximum safety for personnel.

ENCAPSULATED INSTRUMENT TRANSFORMERS—Modern space saving encapsulated instrument transformers are isolated from the breaker compartment. Encapsulated Current Transformers may be conveniently mounted on load and bus sides.

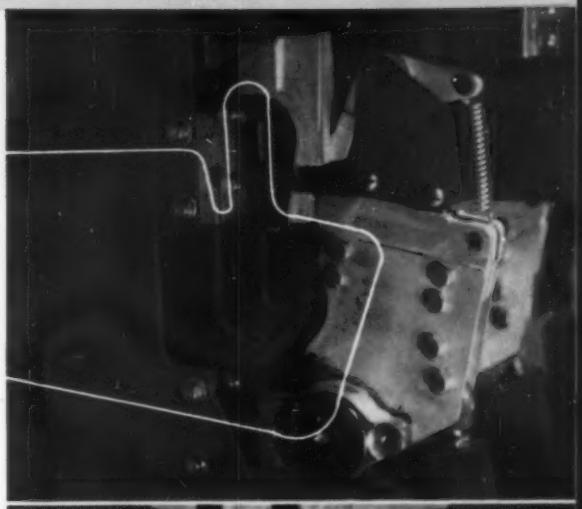
COORDINATED INSULATION SYSTEM—Coordinated insulation system meets individual component insulation requirements. Molded track resistant glass polyester insulation is used on 5 and 15 KV gear. Porcelain is applied on 15 KV gear in critical dielectric locations.

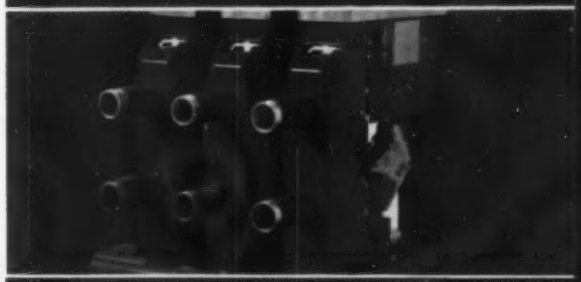
EXCLUSIVE STACK-FIRED BARRIER ASSEMBLY—Zircon arc chute barriers are stacked in uncured state, then cured and fused in one process to provide a mechanically stronger, more uniform, interrupter assembly.

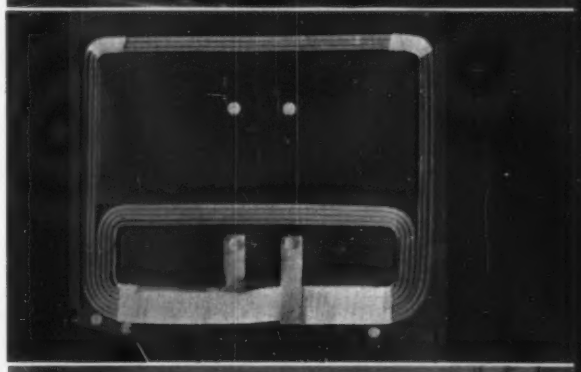
INTER-PHASE ISOLATION—Glass polyester insulation gives positive electrical isolation between phases. Magnetic cores afford magnetic isolation between phases.

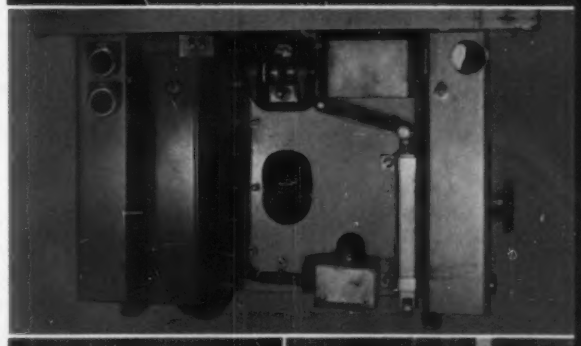
ACCELERATED ACTION OPERATING MECHANISM—Solenoid actuated mechanism provides maximum torque at end of stroke to insure positive contact closing.

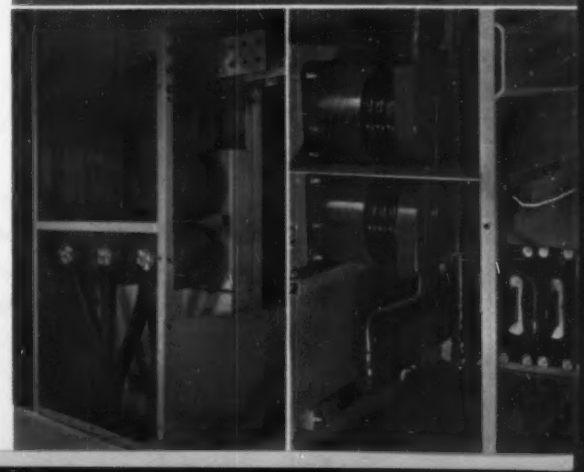
*U. S. Patents Pending

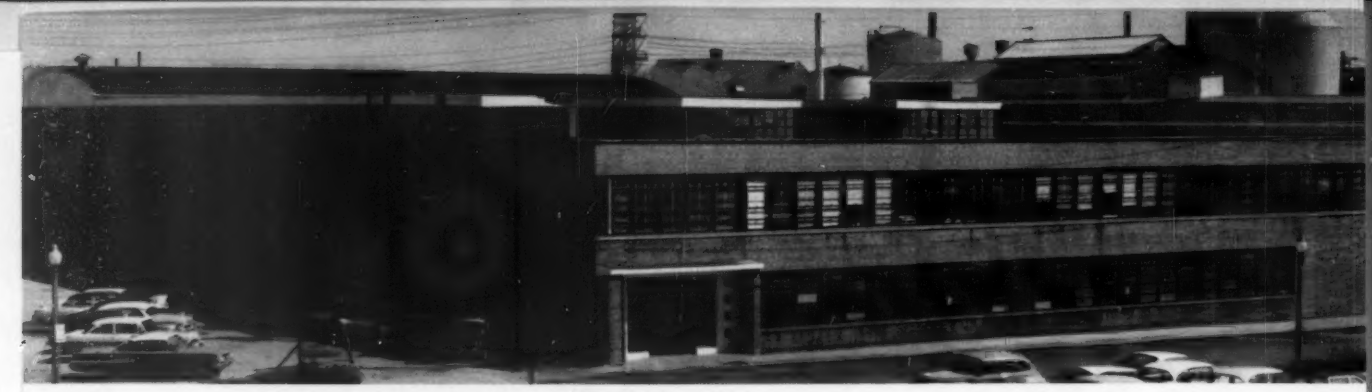












Moloney Switchgear Production facilities at 4330 Geraldine Ave, St. Louis, Mo.

"Establishment of Switchgear Division on the part of Moloney is, I believe, indicative of the company's faith in the future of the electrical industry, and demonstrates our ability and willingness to accept broader responsibilities as a major independent supplier of capital equipment to the industry."

T. O. Moloney, *Chairman of the Board*

"Our entry into the switchgear field reaffirms our position as a progressive company, with strong research and development resources for product innovation and improvement. The introduction of Moloney Metal-Clad Switchgear means that we are expanding our services to the industry, in addition to the specific benefit of bringing fresh, creative thinking to bear on circuit protection problems."

J. J. Mullen, Jr., *President*

"A blend of new engineering concepts and new production techniques, as incorporated in Moloney Metal-Clad Switchgear, brings into being a superior product at a competitive price. With the formation of Switchgear Division, Moloney Electric makes available to users, specialists whose sole purpose is designing, manufacturing and supplying Metal-Clad Switchgear of a quality level the industry has come to expect from Moloney."

D. E. Spackler, *General Manager, Switchgear Division*

"We have incorporated in our Metal-Clad Switchgear, engineering concepts and material applications which represent creative contributions and technical advancements to the art and to the industry."

C. E. Mercier, *Chief Development Engineer, Switchgear Division*

ME61-13

LITHO—U. S. A.

METAL M CLAD Trademark

Switchgear Division

MOLONEY ELECTRIC COMPANY

Manufacturers of Transformers and
Switchgear for Utilities, Industry, and Electronic Applications

4330 GERALDINE AVENUE, ST. LOUIS 20, MISSOURI

SALES OFFICES IN ALL PRINCIPAL CITIES

Readers' Comment

Fan Mail

We have found the article "Minimize Your Mistakes," by Robert Richards, in the December 1960 issue, quite valuable. In fact, we have passed the magazine around until it is becoming worn. If reprints are available, will you please send us 25 copies.

Incidentally, we take this opportunity to thank you for the one magazine we receive which is slanted directly to the engineer in private practice.

Donald E. French
Donald E. French and Associates
Consulting Engineers
Kahoka, Missouri

Many of the more important articles published in CONSULTING ENGINEER *are available in reprint form, without charge in small quantities. In addition, tear sheets of most other articles ordinarily are available, also without charge.*

Corporate Practice

I am enclosing copies of some letters I wrote to several important persons during the last session of the State of Washington Legislature, which explain our reasons for being opposed to Senate Bill 81 as it was finally passed, signed by the Governor, and became our registration law.

I think you should pass these letters along to Dr. Melvin Nord, who seems to think that this was just an emotional fight between groups of different thinking engineers. I think Dr. Nord has missed the problem entirely in his article "Corporate Practice — The Real Issues," in the May issue of CONSULTING ENGINEER.

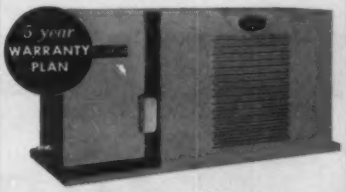
As we see it, Senate Bill 81 opens up the door for contractors and manufacturers to become consulting engineers. When contractors and manufacturers, among others, take up the practice of consulting engineering and sell their services to the public along with the products they manufacture or construct, the true concept of consulting engineering ceases to exist. The system of checks and balances disappears. Contractors and manufacturers will bid against each other, including what they sell or make, and will offer consulting engineering in a package deal. Consulting engineers will be bidding against the contractors and manufacturers and against each other, and eventually the unions will take over our engineering personnel.

The concepts of the consulting engineer, as expressed in CEC's "Manual of Principles and Performance" will become ineffective, and consulting engineering will become a competitive business instead of a profession.

It appears that many other engineers in the State of Washington

SAVE
FACTORY FLOOR SPACE
with
TEMPRITE
REMOTE TYPE
WATER COOLERS

TEMPRITE REMOTE COOLERS mount overhead or behind a wall to save floor space and prevent possible damage to cooler from lift trucks and moving equipment. Models available with water-cooled condensers for use in confined areas or where dust or lint-laden air prevails.



(Above) Temprite Remote Type Water Coolers in four models from 6 to 24 G.P.H.

A complete line of TEMPRITE self-contained water coolers, wall fountains and accessories also available. (Model WF-4000 Wall Fountain illustrated.)

Consult Yellow Pages under "Water Coolers" or write for literature and distributor's name.

Manufactured under rigid quality control by
TEMPRITE PRODUCTS CORPORATION
BOX 72E, BIRMINGHAM, MICHIGAN

Rush me details on Temprite Remote Water Coolers.
Name_____
Company_____
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ROPER PUMPS

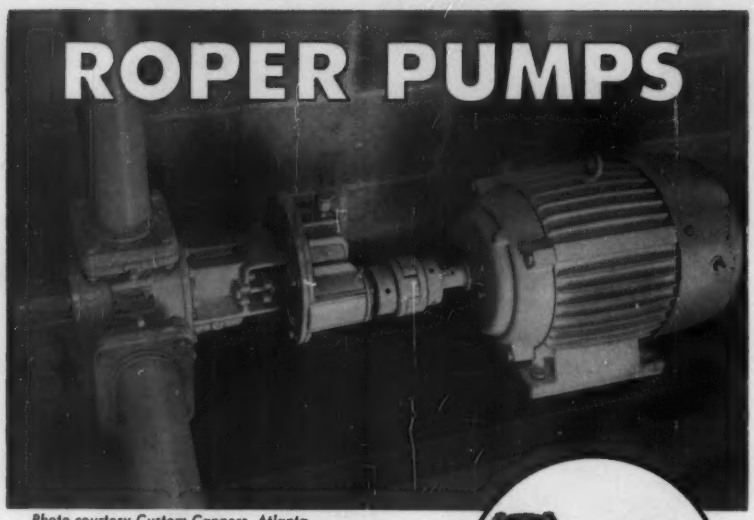
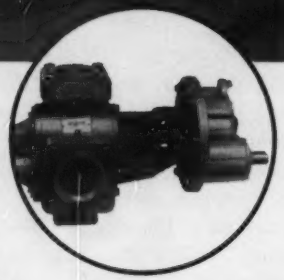


Photo courtesy Custom Canners, Atlanta



SERIES 3600 MAHBRV #4

supply high viscosity liquid sugar in canned soft drink operations

• **OUTPUT CAPACITY: 40-300 GPM** • **PRESSURES TO 100 PSI**

The Potter & Rayfield liquid sugar system installed for Custom Canners, Inc., producers of canned soft drinks, uses Roper Series 3600 MAHBRV #4 as the pumping component. Specification of a Roper unit for the system was made to handle the 10,000 SSU viscosity of the 50% inverted liquid sugar at 60°F, and lower, temperatures. The installation requires consistent output at slow pump speeds. Batch-type production means intermittent pump service, but the unit still handles some 1500-3000 gallons per day. In addition, unloading, transfer to storage, and movement of syrup to mixing vats are handled by the Roper pump, which is connected to a 1800 rpm, 7½ hp motor. Standard, specially modified, and custom Roper units serve original equipment in a wide range of industries — marine, process, chemical and petroleum. A Roper can serve the needs of your equipment also.

Balanced Construction — Reliable Production

- **Axial Hydraulic Balance** of the gears provides vibration-free operation, smooth, pulsation-free output.
- **Gear Construction** includes special machining for tooth forms to insure correct meshing and efficient displacement.
- **Induction Hardening** of steel shaft at bearing and packing surfaces means longer, maintenance-free service.
- **Four High-Lead Bronze** or chrome-iron bearings give balanced support and maintain proper alignment for the helical-type pumping gears. Sleeve bearings are heavy-duty bronze.

For information about your specific pump needs contact your nearest Roper dealer

Send for new 16-page Series 3600 catalog

ROPER HYDRAULICS, INC.

Dependable pumps since 1857

COMMERCE, GEORGIA

either believe that engineering should be a competitive business or they are very much misinformed when they support the present law.

Harold H. Waller, Chairman
ASCE Seattle Section
Legislative Committee
Seattle, Washington

Turnkey Controversy

In the penultimate paragraph of your editorial "New Trend for the Turnkey," you state: "There are many extremely competent engineers in industry, but they have, to a greater or lesser degree, abdicated their right to independent judgment." From my own experience, I do not feel that this is necessarily true — I believe that turnkey propositions can be handled adequately by the designing engineer without any thought of giving up his independence.

In 33 years of various managerial positions in sanitary engineering work, both in the United States and in a large number of foreign countries, I gained the feeling that managements of industrial concerns, faced with orders to cease pollution of streams by their liquid industrial wastes, would welcome any organization that would assume all the headaches of studying the problem, testing the wastes, developing practical and economical methods of treatment, designing the necessary facilities, and building the plant and handing it over as a functioning utility.

I could not execute this idea until I found the proper organization. This must be an outfit engaged in construction and engineering for industries, having an engineering staff, with no tie-ups with manufacturers, and with no inclination to handle the products of others which might be useful in the overall work of solving, specific industrial waste problems.

I did not find such an organization until 1954, when I organized an Industrial Wastes Division for the engineering-contracting firm of Kaighin & Hughes, Inc., in Toledo,

ROBINSON

backs its 100 year guarantee with 100 years of experience*

NEW CLAY PIPE!

New Clay Pipe by Robinson is the product of a century of constant improvement. It's an all-new product, from bell to spigot—longer, stronger, truer, straighter, with snap-together factory joints in your choice of three tested types. Its extra-long sections save jointing time and labor. Its greater density—the result of new vacuum forming and horizontal extrusion processes—provides plenty of strength for deep-backfill situations and live traffic loads. And Robinson offers you Slip-Joint, Wedge-Lock®, or Wedge-Lock® Type "O" joints to speed installation and assure tightness. No wonder Robinson can guarantee New Clay Pipe for 100 years or more!

*Write for a copy of the 100-year guarantee certificate.

THE ROBINSON CLAY PRODUCT CO.
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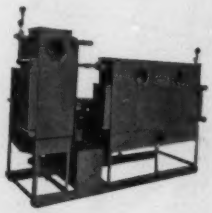
Consulting firms are more and more taking advantage of Kathabar engineers' specialized knowledge about frost-free cooling at sub-freezing dry bulbs and dew points. This knowledge has been accumulated in many successful applications—such as candy cooling, photo film chilling, beer fermentation, ammonium nitrate processing, environmental testing, bakery dipping and icing, and radiant panel cooling.

In all cases, Kathabar equipment eliminates freeze-ups, fluctuating efficiency, defrosting shutdowns, duplicate sets of coils.
Take advantage of Kathabar's fund of specialized knowledge . . .



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Send facts on frost-free cooling for the following application: .....

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name & title .....

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street .....

city .....*zone* .....*state* .....

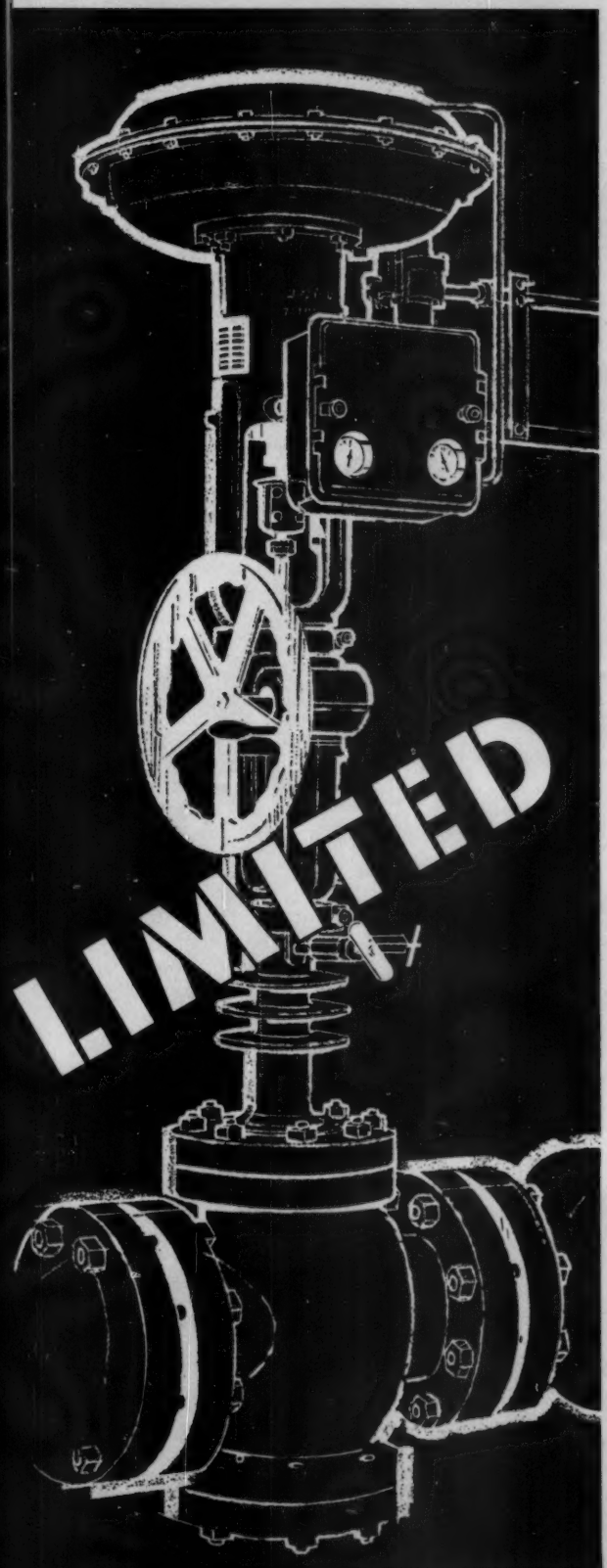
Ohio. One of the basic conditions established by me in forming this connection was in the literature descriptive of this idea:

> "As Kaighin & Hughes, Inc., does not and will not represent any manufacturer of equipment or accessory devices, the client, his engineer, or his architect may select the equipment and devices preferred by him, if believed (by me) to be suitable for the successful performance of the plant."

Proof that this idea was sound, and was a plan that the industrial managements would consider, was the call, right after the first announcements went out, from one of the largest manufacturers of automobiles. They had a very large and complex waste problem of toxic wastes and wanted just what we offered. Consequently, after the usual conferences, they contracted us to study, design, and build the necessary plant. The final cost of this entire operation, for one of the largest plants of its kind ever built, was much less than the cost of plants of similar size and type at other locations.

This initial project was the forerunner of a number of others on various types of wastes, and bore out the feeling that the turnkey idea was sound and could be administered without any loss of independence of thought or execution on the part of the engineer responsible for the basic design. It was testimony to the fact that an engineer could be engaged to work out solutions for complex problems in a manner that not only satisfied the regulatory authorities but benefited the client from a monetary standpoint. It showed that an engineer, if he organized his work on the proper basis and formulated his plans with the backing of the higher echelons of campany officials, need not "abdicate his right to independent judgment."

Edmund B. Besselievre, P.E.
Consulting Engineer
Dallas, Texas



Why Did We Stamp LIMITED on That Valve?

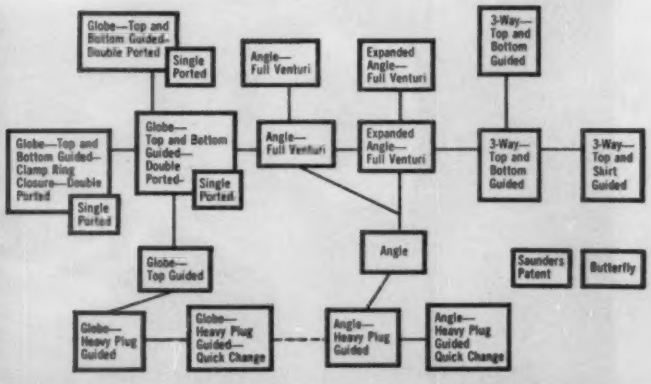
The answer is simple. It's because our control valves **are** limited to **specialized jobs.**

And, why not? When you need a valve you are only concerned that it fits the job at hand, and that it satisfies the process requirement. Each of our valves is designed to do one specific job and do it well. Isn't that what you really want in a control valve?

Take our SUPER 70 line – outlined below. With the many specialized valves and the variety available to you through a selection of internals and accessories, no line can offer you more. In this line you can find the one valve which is **limited** to the job you want done.

If this concept of control valve service makes sense to you, call or write us today.

The Super 70 Family of Valves



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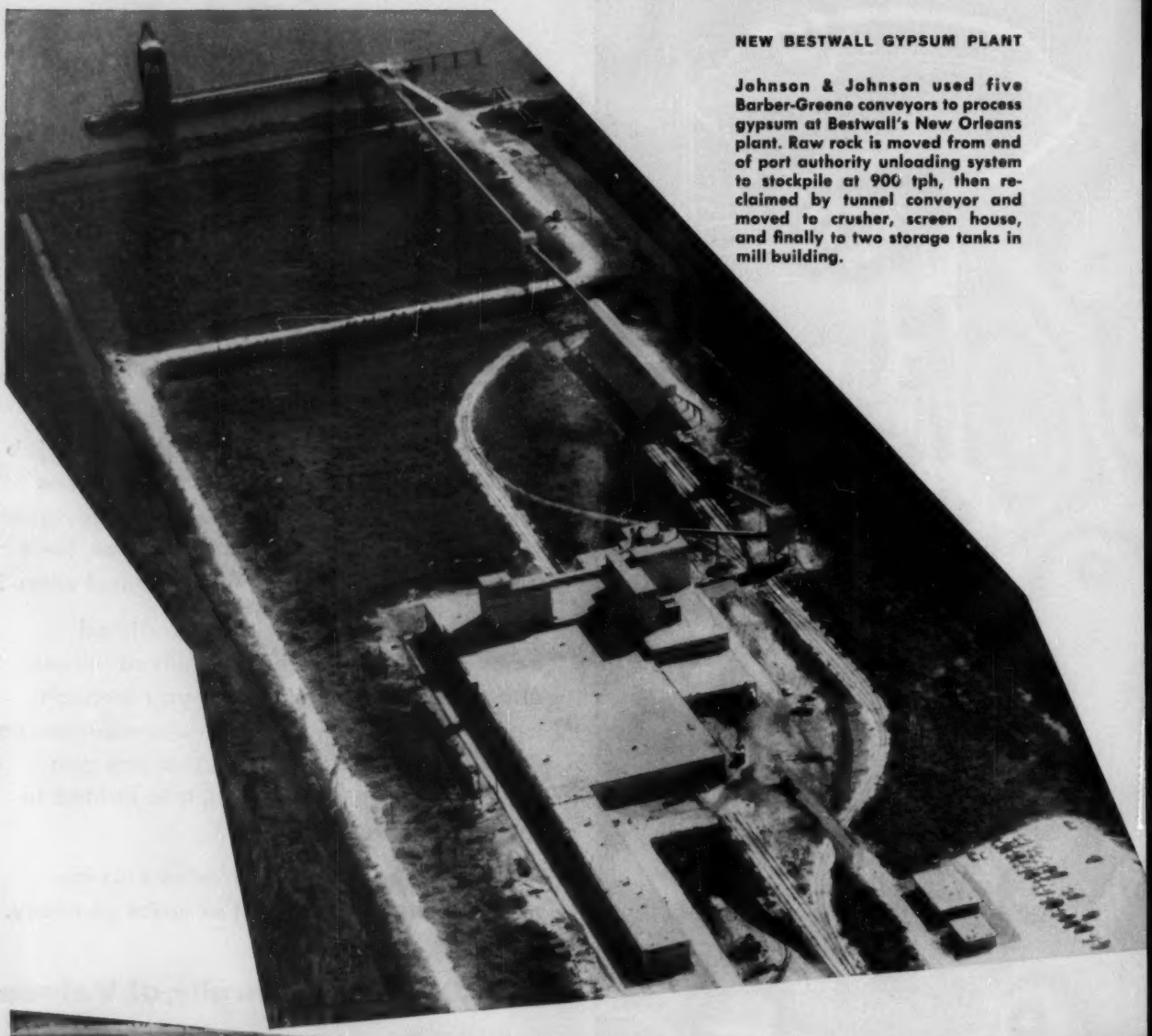
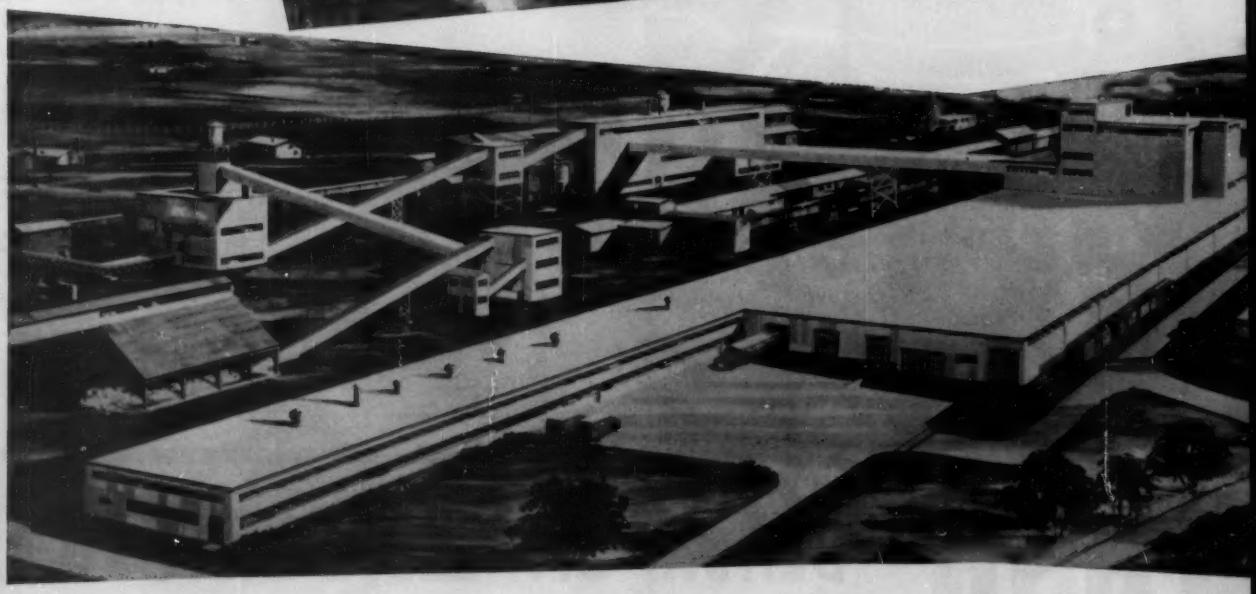


NEW BESTWALL GYPSUM PLANT

Johnson & Johnson used five Barber-Greene conveyors to process gypsum at Bestwall's New Orleans plant. Raw rock is moved from end of port authority unloading system to stockpile at 900 tph, then reclaimed by tunnel conveyor and moved to crusher, screen house, and finally to two storage tanks in mill building.



Why Johnson & Johnson used Barber-Greene conveyors on Celotex, Bestwall jobs

Johnson & Johnson, Engineers-Architects, Inc., Chicago, is one of many leading engineering firms taking advantage of Barber-Greene's extra services when designing projects that include materials handling systems.

Two projects typify results of close cooperation between Johnson & Johnson and Barber-Greene engineers. These are the Celotex Corp. gypsum plaster and wallboard plant at Port Clinton, Ohio, and the Bestwall Gypsum Company plant at New Orleans, La.

On both projects, the raw materials handling systems consisted of Barber-Greene belt conveyors. And on both projects Barber-Greene supplied products and experienced personnel that helped solve materials handling problems in the most efficient manner.

When you call in Barber-Greene, you get the benefit of vast experience in designing and building conveyor systems for use in all industries, and for handling nearly every bulk material, from coke to manganese ore, plus:

- A complete line of conveying equipment from the simplest to the most complex heavy-duty, high-capacity systems.
- Ability to determine the best solution to a materials handling problem, lay out the system, and design and fabricate the required equipment, or to manufacture according to your design and specifications.
- Cost analyses for use in evaluating various systems and plant layouts and estimates or firm quotations on proposed equipment.
- Complete erection drawings, experienced supervision, or full responsibility for erection and start-up, whichever best suits your and your client's requirements.
- Service and repair parts immediately available through world-wide distributor network.
- Follow-through on order to assure accurate fabrication and on-time shipment.

Your letter or phone call puts Barber-Greene's 45 years of experience in the design and manufacture of materials handling systems to work for you and your clients.

Products and personnel offering the ultimate in service

Representatives in Principal Cities of the World

Barber-Greene BG

Main Office and Plant AURORA, ILLINOIS, U. S. A.
Other Plants: DeKalb, Milwaukee, Detroit, Canada, England, Brazil, Australia

CELOTEX EXPANSION DOUBLES PLANT CAPACITY

At Port Clinton, Ohio, Johnson & Johnson handled a large expansion and modernization program for the Celotex Corp. An important equipment choice in this program that doubled capacity of plant shown at left were 11 Barber-Greene conveyors that move gypsum in its many forms—from raw, heavy rock to fine, finished plaster.

Right view is inside one of galleries at Celotex showing two conveyors transporting processed gypsum.

From the Editor's

Tranquil Tower

Where to Advertise

On April 19, the American Medical Association broke a seven-column ad headlined "Medical Care for the Aged" in 30 metropolitan daily newspapers. The ad is appearing, and probably will continue to appear, in many other local papers under the sponsorship of state and county medical associations. Even for the highly vocal American Medical Association, this is a big campaign. It is an attempt to get grass roots support for AMA's battle against medical care for the aged under the Social Security program. Since medical care is a highly controversial issue, this campaign undoubtedly will provoke widespread comment.

Readers of AMA's ad, regardless of personal convictions about medical care, cannot help but admire the Association for its unequivocal stand. Sick or well, Americans know AMA is against socialized medicine.

The fact that consulting engineers, through CEC and NSPE, also are fighting for the preservation of free enterprise might tempt them to take the bold approach adopted by the medics. There is good reason to believe that socialized engineering is already far more expensive to the general public than socialized medicine ever could be. However, at this point, the general public seems to have taken no firm stand on the question of socialized medicine, even though almost everyone has had occasion to deal with a doctor. Thus, it would be rather naive to assume that consulting engineers could marshall public opinion against socialized engineering when, as a matter of fact, the general public is almost isolated from contact with consulting engineers. Consulting engineers have a long row to hoe before they can carry the battle for free enterprise engineering before the general public.

Some time ago, the Massachusetts Association of Consulting Engineers made an abortive attempt to explain the hows and whys of consulting engineers to the general public through the medium of a Boston newspaper. In this instance, public ignorance of the profession combined with political skulduggery doomed the project to failure. It may be hasty generalization, but there is good evidence that even had this campaign been undertaken on a national scale, it would have met with the same result. The general public does not yet appreciate the consulting engineer, and is, therefore, not yet ready to listen when he speaks.

This is not to say that consulting engineer groups should not advertise. An example of the kind of advertising that might prove helpful to consulting engineers is that now being done by the National Electrical Contractors Association. Last April they ran a half page ad in *Electrical World*. It was not a great ad: "Next time you need line crews, consider the advantages of using a qualified contractor's facilities. You'll spare yourself the usual headaches of hiring and laying off, employee processing and training, absenteeism, etc. For special projects — or on a long range basis — the qualified contractor offers:

¶ The skills and equipment you need when and where you need them

¶ Precise cost accounting

¶ Reduced equipment overhead

¶ Firm job completion dates and written performance guarantees

In addition, he can probably do the job at less cost."

To be sure, NECA members are looking for work, and maybe this ad will bring it to them. More important, however, is the fact that they have presented a portrait of themselves to many people who may never be in a position to hire them, but whose sympathy and understanding is important. This advertisement in a daily newspaper would create hardly a ripple; in a business magazine it makes quite a splash.

If consulting engineers are ever in the position of being ethically and financially able to advertise, it is to be hoped that they will look first at the business press. Here they will find an audience of fellow engineers and businessmen whose sympathy and understanding can be gained. Once that foundation has been firmly laid, consulting engineers will be ready to go to the general public — but not before. ▲▲

HERE'S HOW BORDEN FLOOR GRATING CUTS COSTLY FIELD CORRECTIONS . . .

Insures correct dimensions, fit, and placement . . .

1. A shop drawing of the job is submitted to the customer for approval, when necessary. This plan shows the size and shape of the grating area — how grating clears all obstructions.
2. Each finished panel is carefully checked for accuracy of dimensions.
3. Each panel is plainly marked with its number to insure quick, easy installation.
4. The entire platform is laid out on our shop floor. Overall dimensions and obstruction openings are checked against shop drawings.
5. Erection diagram showing panel mark numbers is supplied for field installation.

Write today for *free*
16-page catalog showing all basic types of grating; more than 30 dimensional drawings of subtypes; eight safe load tables for steel and aluminum grating.

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"Greatest name in gratings"

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BORDEN METAL PRODUCTS CO.

Gentlemen: Please send me NEW 1961 BORDEN Catalog

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Owner: **Western Hotels, Inc.**
Electrical Engineer: **Mr. Fritz Klawa,** Portland, Ore.
Electrical Contractor: **Pitman Electric Co.,** Portland, Ore.

Electrical Protection is MODERNIZED with BUSS Fuses in the Multnomah Hotel, Portland, Ore.

In this well-known hotel of the Northwest, it became necessary to modernize the electrical system to take full advantage of the many uses for electricity today.

BUSS Hi-Cap and FUSETRON dual-element fuses were installed to assure safe, dependable and lasting protection.

This installation is another example of the modern trend in electrical protection. Architects, engineers and plant operating men are finding no other type of protective device can equal fuses for high-interrupting capacity and lifetime, maintenance-free dependability.

FUSES PROVIDE HIGH INTERRUPTING CAPACITY

at a very low cost

FUSETRON dual-element fuses have an interrupting rating of 100,000 ampere rms symmetrical—and for the protection of mains or circuits above 600 amperes, BUSS Hi-Cap fuses are designed to safely interrupt 200,000 ampere rms symmetrical.

Thus, they can safely interrupt fault currents now available,—and are adequately safe to allow for future system growth.

Mr. J. Wesley Birch, Manager of Pitman Electric Co. at main switch board which is equipped with BUSS Hi-Cap and FUSETRON dual-element fuses.

WITH FUSES, SAFE PROTECTION REMAINS SAFE WITHOUT MAINTENANCE OR RECALIBRATION COSTS

After years of inactivity, fuses will provide the same safe, accurate protection if called upon to open as they would on the day installed.

Fuses have no hinges, pivots or contacts to stick or get out of order. Dust, fumes, corrosion or age cannot increase the capacity of fuses or lengthen their blowing time.

For more information:

Fusetron dual-element fuses.....write for bulletin FIS
BUSS Hi-Cap fuses.....write for bulletin HCS

BUSSMANN MFG. DIVISION, McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

If you need fuses with long time-lag to prevent needless blows, plus 200,000 amp interrupting capacity, plus extreme current-limitation—use **BUSS LOW-PEAK** *fuses.*
Ask for BUSS bulletin LPCS.

When It Comes to Humidification . . .

Here is some information to consider:

The use of dry steam is very often the simplest way to humidify.

Advantages of Steam Humidification

1. Steam is ready-made vapor which merely has to be mixed with air in the duct system or discharged to the humidified area.

2. Steam is pure water vapor—no mineral dust as comes from evaporated water droplets.

3. Steam may be shut off immediately when control is satisfied.

4. Steam comes on immediately when control calls for humidity.

5. Duct system and air handling units are always dry. Thus, there is no odor, no growth of algae or bacteria, no corrosion problem.

Armstrong Steam Humidifiers are scientifically designed, automatically controlled steam valves for admitting steam vapor to the humidified area, either directly or into the air stream in ducts or plenums. The humidifiers dry the steam and muffle the noise of the discharge.

Thousands of Armstrong units are used successfully in industries working with hygroscopic materials, in offices, plants and institutions for improving health and comfort conditions and in offices, plants and institutions for control of static electricity. Every installation is backed by a sales and service network that blankets the United States and Canada.

Advantages of Armstrong Humidifiers

1—Low cost and large capacity.

2—Minimum maintenance, proved by thousands of installations.

3—Quiet operation.

4—No carry-over or drip.

5—Immediate response to control.

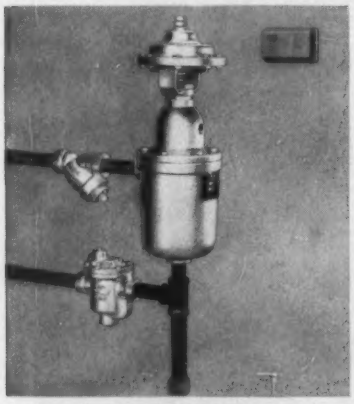
6—Low operating expense.

7—Guaranteed tabulated capacities.

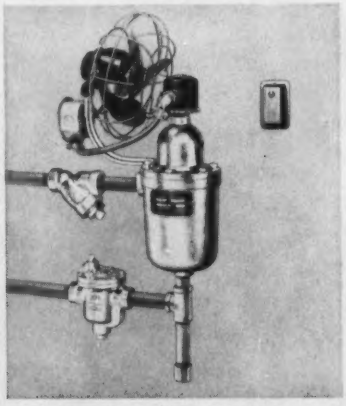
8—Selection is simple and easy.

9—Small space required makes duct design easy.

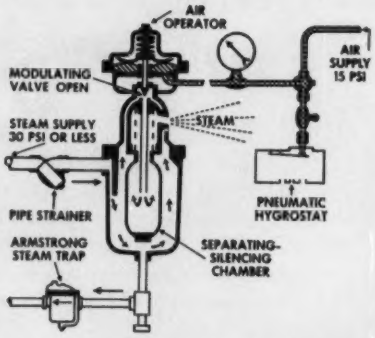
10—Easy installation.



AM-32 Air-Modulating Humidifier complete with strainer, trap and hygrostat. AM-33 similar.



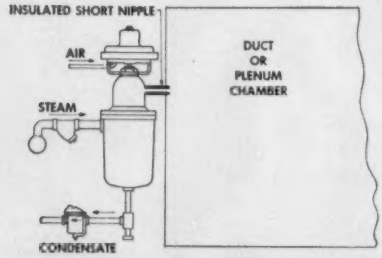
FCL-2 Humidifier complete with fan and motor, humidistat, fine mesh strainer and trap. FCL-3 similar.



HOW THEY WORK

Air-Operated Units—When relative humidity drops slightly below desired level, the pneumatic hygrostat increases air pressure in operator to open modulating valve in proportion to demand. When demand is satisfied air bleed closes the valve. Air-operated units usually discharge to ducts or are installed in plenums.

Electric Units—When relative humidity drops slightly below desired level, humidistat energizes solenoid to open steam valve and start fan. Steam flows through muffler to atmosphere and is dispersed by fan. When desired humidity is reached, humidistat closes valve and stops fan. Units with fans normally discharge to the atmosphere. Units without fans available for discharge to ducts.



Typical installation of Armstrong Humidifier discharging dry steam to ventilating air duct.

TYPICAL CAPACITIES

Capacities for representative steam pressures expressed in pounds of vapor per hour added to the atmosphere. Capacities for intermediate pressures will be furnished on request.

Steam Pressure	Model No.	Air Operated			Electrically Operated		
		AM-32	AM-33	DA-34	FCL-2 or DCL-2*	FCL-3 or DCL-3*	CK-4
	2	48	85	145	48	85	145
	5	84	149	350	84	149	340
	10	122	217	645	62	166	610
	15	154	272	900	78	209	810
	20	181	321	1080	62	181	980
	25	205	364	1230	70	205	1130
	30	229	407	1425	78	229	1280

*FCL models are equipped with fan. DCL models have no fan and are tapped for 1" connection to air duct.

For Complete Information

SIXTEEN-PAGE BULLETIN NO. 500 contains a wealth of information about humidification. Tells: how relative humidity affects products and profits . . . other effects of relative humidity . . . recommended humidities for various operations . . . advantages of Armstrong Steam Humidifiers . . . how present users have profited . . . complete data and prices on all Armstrong humidifiers . . . selection and installation data. To get your copy, just call your local Armstrong Representative or write

ARMSTRONG STEAM HUMIDIFIERS

ARMSTRONG MACHINE WORKS 9659 Maple Street—Three Rivers, Michigan

Manufacturers of Armstrong Inverted Bucket Steam Traps

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Heard Around Headquarters

MARJORIE ODEN,
Eastern Editor

NYSACE Meets at Buffalo

Dues, stock school plans, and membership were the three leading topics at the recent meeting of the New York State Association of Consulting Engineers.

As President Realto E. Cherne explained, "Our Association and our parent Consulting Engineers Council together have a financial problem that cannot be ignored. We stand in good company with most of the technical societies in this respect. Changing from membership by individual to membership by firm has temporarily complicated the picture. Fundamentally, there are too few members to support a program which will accomplish major objectives in a short period of time."

Cherne recommended that the problem be approached through continued State Association membership drives, which have been successful in the past. Last year, NYSACE had 68 member firms in five regional chapters, and a new Eastern New York Chapter in Albany, just added, has 17 member firms. Joseph Ottenheimer is acting president of this new chapter.

The New York State group decided to continue to collect dues annually, but to pay CEC quarterly as required. There were complaints that CEC is geared to one-chapter organizations, and in the past has not given enough warning of dues deadlines for all New York State chapters to be notified in time. However, as one member put it, "I don't care what they charge as long as they quit talking about it."

New York architects and engineers share a common concern over stock school plan legislation. State AIA directors have instructed their fees committee to withhold any action until the degree of responsibility involved in the use of stock plans has been defined. State Association members agreed to work as closely as possible with the architects and with the New York City Association in deciding how to handle stock school jobs.

A legislative action committee is to be formed to formulate a positive program of legislative goals, and it was suggested that this be followed by local meetings with state and Federal representatives in the fall. It was reported that legislators frequently would be willing to help if they knew what the engineers favored — not merely what they opposed.

This year, the State Association, along with other engineering groups, was successful in opposing a bill allowing corporate practice, plus a bill to establish "professional safety engineers." Another defeated bill would have termed persons doing engineering, surveying, drafting, and architectural work as "workmen." A bill, approved and passed, requires an engineer to sign and seal all his drawings.

At the request of CEC, the State Association put on record its view

A discussion at NYSACE meeting. Left to right: NYSACE president Cerne; CEC vice president Acheson; speaker Dr. John Findley; delegate Don Brill.

on surveyor membership in CEC. The New York State group favors the CEC proposal to leave the question of surveyor membership to the discretion of individual member associations, provided the professional requirements for becoming a land surveyor are comparable to those for becoming an engineer.

Cut Government Engineering?

Representative Ostertag, of New York, has introduced a bill that would remove the government from competition with private practice. Although this bill is never expected to get out of committee, it is encouraging to see these sentiments expressed legislatively.

The Act, labeled the "Anti-Government-Competition Act," suggests that "Congress hereby declares it to be the policy of the Federal government to encourage private competitive enterprise to the maximum extent consistent with national security and the public interest. Certain activities of the Federal government involve the production of goods and the rendition of services commercially available from private business enterprises. Such activities of the Federal government unduly weaken private business enterprises, and result in the deprivation of governments at all levels of tax revenues . . .

"It is declared to be the policy of Congress that the Federal government shall not engage in business-type activities except where it is necessary for the government itself to perform such activities in the public interest or in furtherance of national programs and objectives established by statute."

Teamwork in Oregon

A 35-page memorandum, pointing out the encroachment of government into private enterprise, has been presented to Oregon congressmen by the Consulting Engineers Association of Oregon, the

S. Franks of OCAIA, and Harry Cyzzewski of CEAO, with joint petition.

Oregon Chapter of the American Institute of Architects, the Portland Chapter of the Associated General Contractors, and the Oregon Technical Council.

Exerpts from the memo cite the general philosophy of this trend toward government encroachment:

¶ "Several Legislatures ago, a bill was passed in which the TVA was authorized, among other things, to do "free engineering" in order to assist private enterprise in locating

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CERTIFIED RATINGS
Certified Ratings are the result of tests made by the manufacturer in accordance with Standard Test Codes adopted by the Air Moving and Conditioning Association, Inc., successor to Industrial Unit Heater Association, National Association of Fan Manufacturers, Inc., and Fewer Fan Manufacturers Association.
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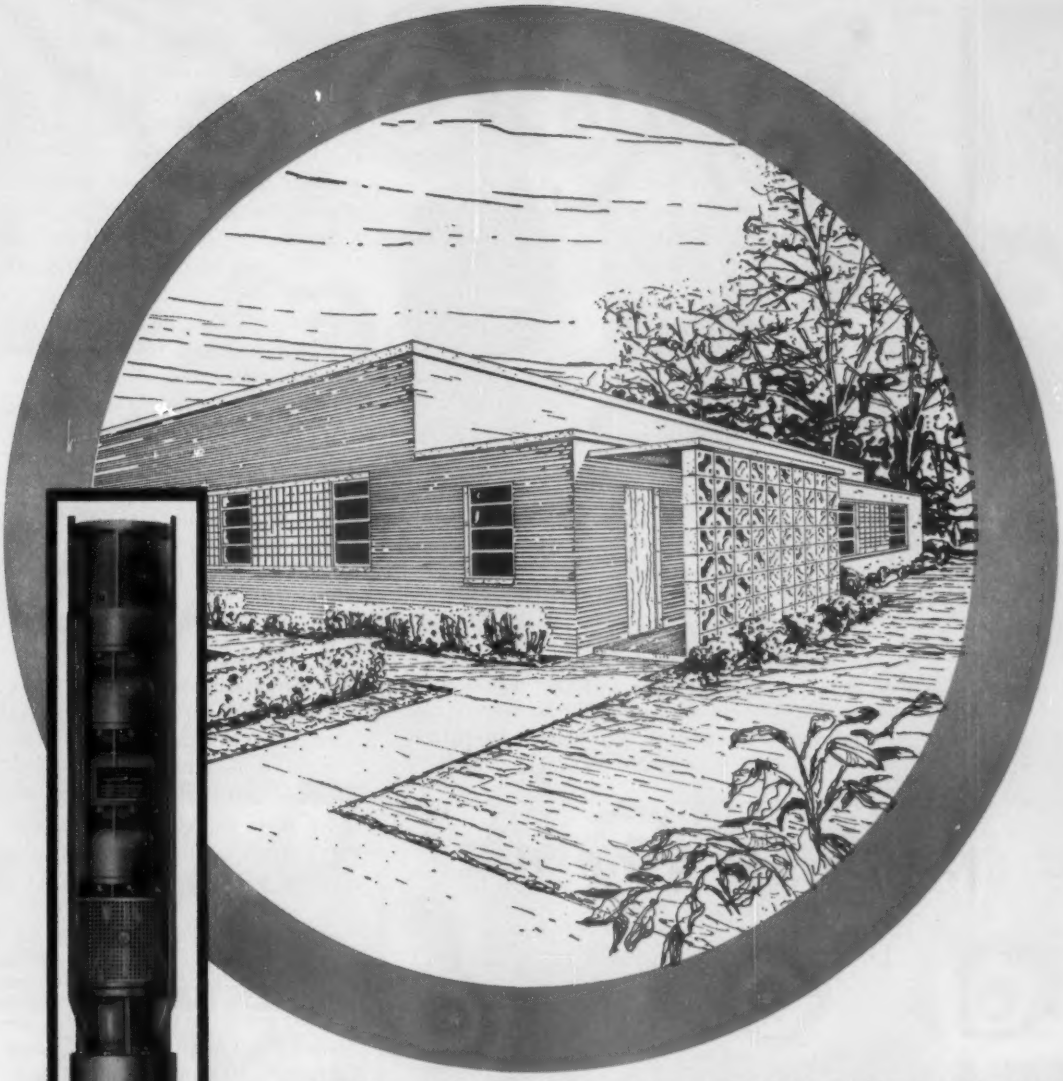
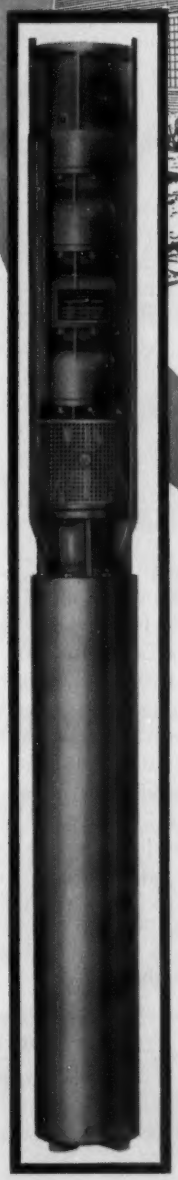
AMCA IS BEHIND THIS SEAL—Only manufacturers who meet the rigid requirements for testing and rating air moving devices under the certified ratings program are licensed by AMCA to use the Certified Ratings Seal.

PROPERLY-RATED PERFORMANCE IS BEHIND THIS SEAL—Only performance rating data developed in accordance with AMCA standard test codes, and based on tests conducted only in AMCA-approved laboratories is accepted for review and license consideration under the certified ratings program.

A CONTINUING RE-TEST PROGRAM IS BEHIND THIS SEAL—All products licensed to use the certified ratings seal are subject to periodic re-evaluation under AMCA's continuing re-test program, and license to use the Seal may be withdrawn by AMCA for non-conformance with requirements.

For a list of manufacturers participating in AMCA's certified ratings program, write: Air Moving and Conditioning Association, Inc., 2159 Guardian Building, Detroit 26, Michigan.





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Presidents of three major engineering groups at CEC Board of Directors Meeting: Glenn Holcomb, ASCE; Harold King, CEC; and Gerald McCarthy, AICE.

in the TVA distribution area. Why help one segment of private enterprise at the expense of private enterprise services of engineers in private practice? It was only necessary that the government arrange for the engineering to be done by consulting engineers. The government is skilled in applying checks and balances to see that frauds and incompetents are kept out of such programs.

¶ "A second example — our grand Federal network highway program. When this legislation was passed, it was hailed as a great boon to private enterprise. Certainly the government did not insist that its own forces construct the highways. Yet, somehow the working of the bill became interpreted to read that the use of engineers in private practice in this highway program was to be discouraged by the Comptroller General and instead that the state highway departments be expanded. Was it the intention of Congress that only part of the private economy, that performed by contractors, be encouraged and no other? We believe not; yet, that was the end result of the legislation. Can this be corrected now?"

Signers of the memo requested cooperation of the legislators, and promised to keep them advised of specific bills as they develop.

New Jersey Meeting

The New Jersey Association of Consulting Engineers is preparing a private enterprise package of form letters which will be sent by association members to legislators. The aim is to clear the air of attacks made in Washington against the use of consulting engineering services on government projects. July 1st was set as a deadline for the kit's completion. The New Jersey group also plans a visit to Washington this summer.

At its recent annual meeting, attended by Charles Pate, former Consulting Engineers Council president, the New Jersey Association appointed John G. Reutter as liaison chairman with CEC. Reutter's job will be to gather information from CEC member groups on their committee activities in order to develop fresh ideas and avoid duplication of effort.

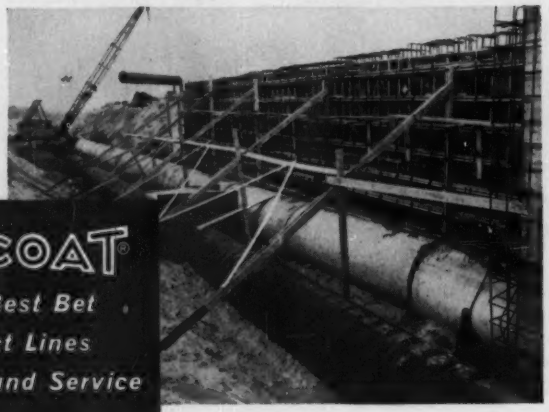
The new president of the New Jersey Association is Donald Goodkind, of Goodkind & O'Dea, Bloomfield, New Jersey.

Federal Moonlighting

Secretary of Defense McNamara has issued a directive that Defense Department employees shall not do moonlighting from their

NO PLACE TO GAMBLE

Joints on steel plant water line are TAPECOATED to provide protection equivalent to coating on the pipe.



TAPECOAT® is Your Best Bet to Protect Lines in Underground Service

You take no chances when you specify TAPECOAT coal tar coating in handy tape form for pipe, pipe joints, fittings, couplings, tanks, tie rods, and conduit on new construction or for maintenance.

Since 1941, TAPECOAT has proved its superiority in resisting moisture, acids, alkalis, and other severe corrosive and abrasive conditions.

TAPECOAT comes in rolls of 2", 3", 4", 6", 18" and 24" widths. It is easy to apply with the use of a torch to bleed the coating which serves as both bond and protection. No skilled help required.

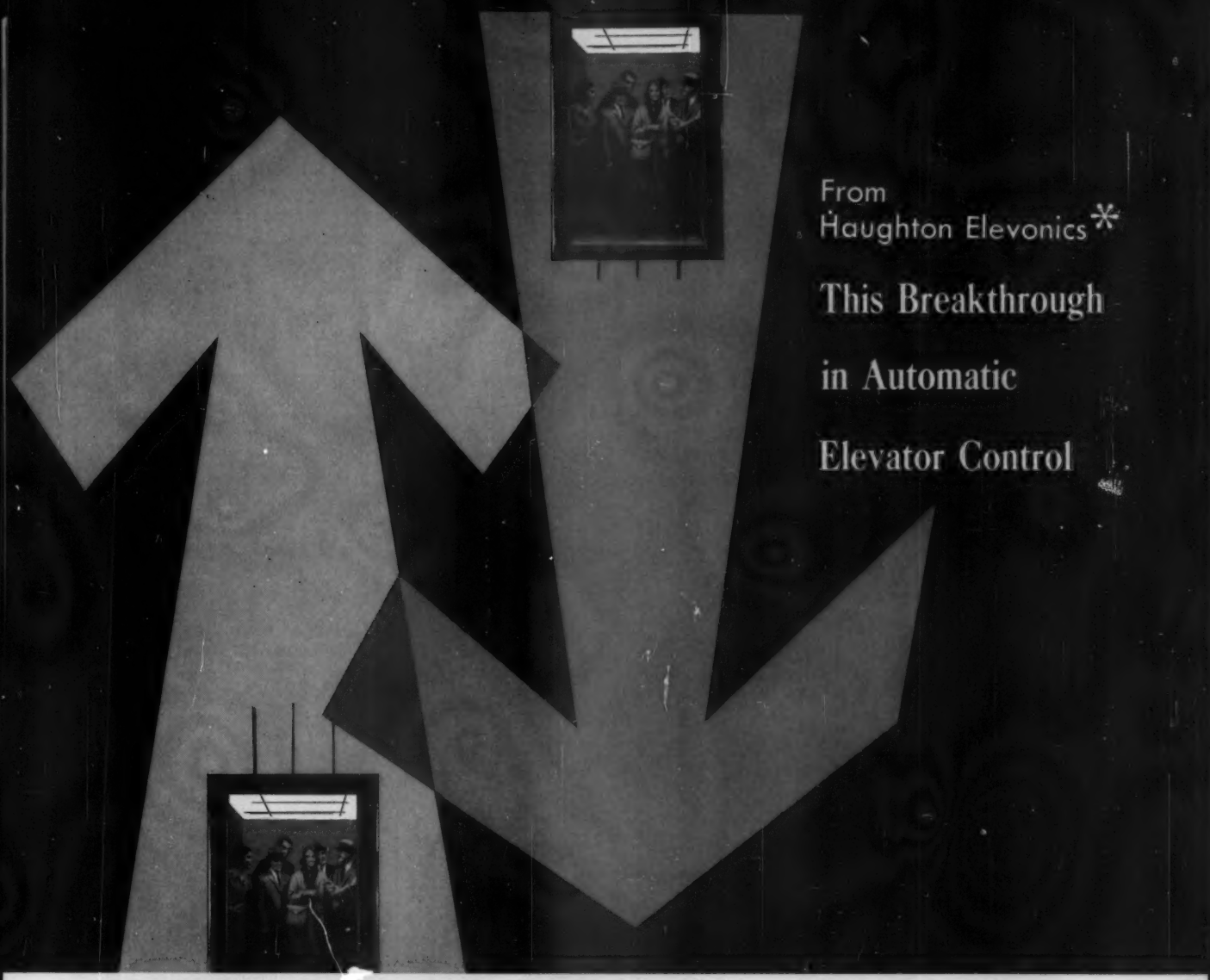
A TAPECOAT sales and service engineer is ready to help you on any corrosion problem. Write for details today.

Originators of Coal Tar Coating in Tape Form

The TAPECOAT Company 1569 Lyons Street, Evanston, Ill.

Representatives in Principal Cities

Manufactured and distributed in Canada by The Tapecoat Company of Canada, Ltd.
25 Haas Road, Rexdale, Ontario



From Haughton Elevonics*

This Breakthrough in Automatic Elevator Control

DYNAFLITE

Now every trip can be incredibly fast and smooth . . . *for unparalleled service*

Imagine floor-to-floor travel so smooth you can barely sense acceleration and deceleration . . . and faster than engineers thought possible a few years ago. It's a practical reality today, with Haughton Dynaflite . . . bold new concept of operatorless elevator control for new buildings and old.

The Dynaflite System is fully automatic . . . thoroughly reliable. Every run is as precisely controlled as those that preceded it, and those that will follow.

Dynaflite is but one result of the magic of Elevonics* . . . which, today, is shaping the new technology in vertical transportation. Get all the facts on Dynaflite, as well as Haughton's complete design, modernization and maintenance capabilities. The Haughton representative in your area will gladly consult with you—no obligation, of course. Or, write today.

EMBLEM OF EXCELLENCE IN VERTICAL TRANSPORTATION

Haughton Elevator Company

DIVISION of TOLEDO SCALE CORPORATION • Toledo 9, Ohio

OFFICES IN PRINCIPAL CITIES

• PASSENGER AND FREIGHT ELEVATORS
• DUMBWAITERS • ESCALATORS

* Haughton's advanced program in elevator systems research and engineering, with specific emphasis on the creative application of electronic devices and instrumentation for betterment of systems design and performance. Registered in U.S. Patent Office.

offices. "No defense employees may use, or permit the use by others, of government facilities, property, man power, or funds for other than official business."

Private Surveyors Barred

A recent memorandum sent to all Department of Agriculture State Offices is just another drop on the stone, cutting out private practice. The memo states:

"It has been the practice in some counties to accept determinations by licensed surveyors hired by individual farmers. In general, such determinations were found to be accurate and allowed the county offices some savings in performance expense.

"It has been determined that acreage determinations by engineers and surveyors hired by individual farm operators will not be accepted for compliance purposes. This is a policy decision dictated by the responsibility of the ASC organization for making acreage determinations to check compliance with the allotment and soil bank programs.

"Inform producers who propose to submit acreage determinations by engineers or surveyors that such determinations cannot be accepted. County office personnel will make all acreage determinations . . ."

Mailing Costs

A recent survey of industrial and service organizations in the United States and Canada, taken by the National Office Management Association, showed that an evaluation of mail room activities could result, for most firms, in a savings ranging from hundreds to thousands of dollars per year.

Among the findings:

¶ Many firms have mail room employees start work earlier than normal office hours so mail can be distributed before the beginning of office hours.

¶ Eighty-five percent of the companies give periodic instruction on mail room procedures and postal regulations to mail room employees. In addition, many firms conduct periodic checks in all departments to be sure proper mailing procedures are being observed.

¶ Seventy-one percent of the U. S. companies and 90 percent of the Canadian companies think postal rates are too high for the services rendered by their post offices.

Southern California architects and engineers contribute $2500 to Paul Jeffers memorial scholarship fund set up at Stanford Engineering School by Structural Engineers Association of Southern California. L to R: CE Henry Lane; Prof. James Gere, Stanford; Arthur Froelick, AIA; CE Roy Johnston.

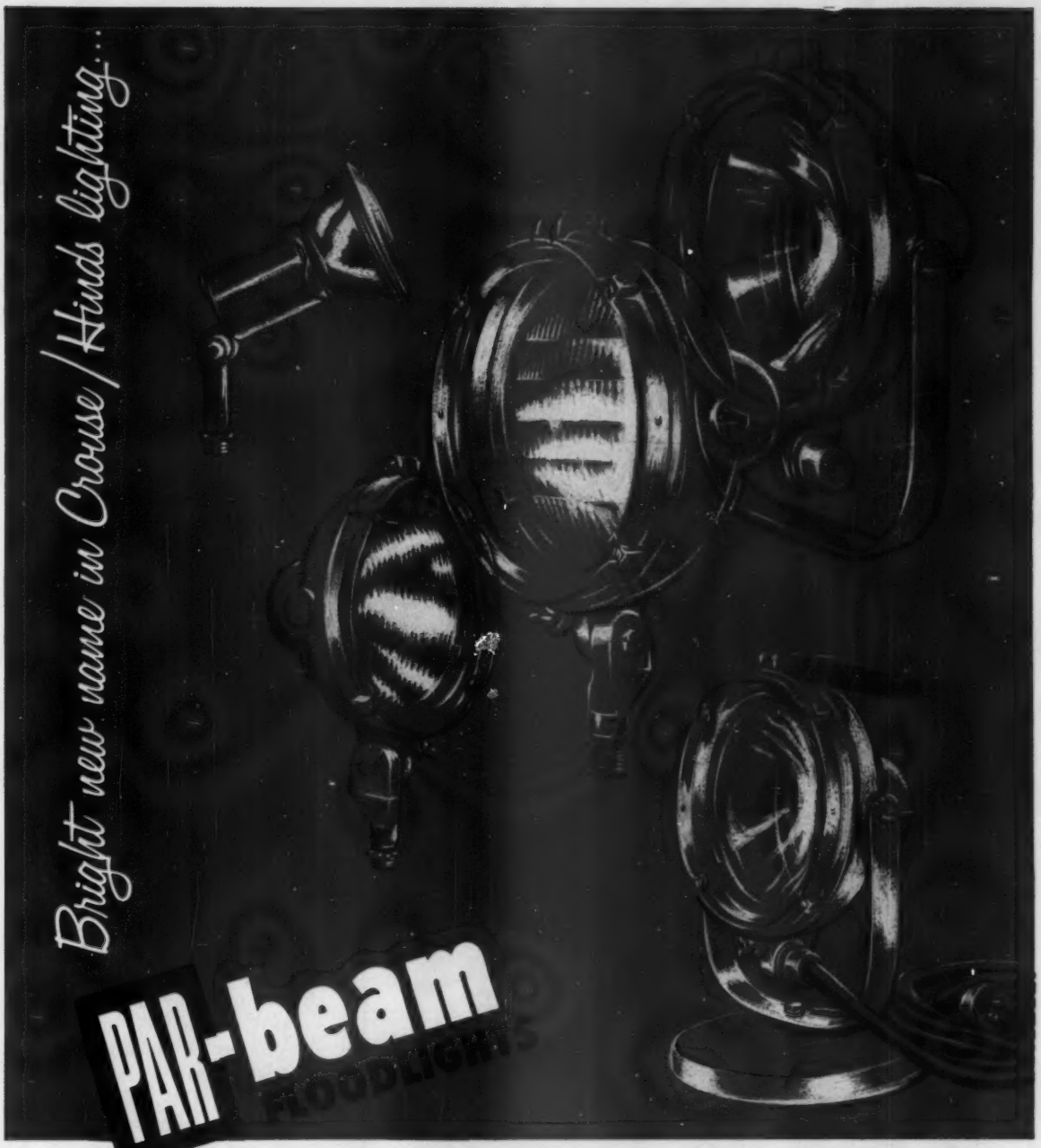
What's the biggest name in steel heating boilers?
PACIFIC!
Pacific makes the most complete line of low pressure steel heating boilers. Has specialized in designing and building large steel boilers for close to 50 years. Thousands of installations the world over. You benefit because Pacific men are boiler experts. There's a Pacific representative in your area. Call him for your next boiler.
PACIFIC STEEL BOILER DIVISION
Division of Crane Co., Johnstown, Pennsylvania
AT THE HEART OF HOME AND INDUSTRY
CRANE
VALVES AND PIPING • ELECTRONIC CONTROLS
PLUMBING • HEATING • AIR CONDITIONING

Ambitious Plumbers

Plumbing contractors, in their proposed Illinois bill for certification, describe themselves as a person, firm, association, partnership, or corporation engaged in the business of installing, planning, engineering, superintending, maintaining, designing, or repairing plumbing. Engineers have requested that the plumbing contractors delete the references to planning, engineering, and designing. The chief sanitary engineer of the State Department of Public Health has indicated he has no objections to the engineers' suggested revisions.

Free Engineering

Two firms have notified officials of the National Society of Professional Engineers Functional Section for Consulting Engineers that they no longer will advertise free engineering. The Wilson Concrete Company of Omaha is modifying its brochures to eliminate the offer



Here's an all-new sealed beam floodlight series you'll want to know all about! Covering the entire range of applications, the new Crouse/Hinds PAR-beam Floodlights are available as follows: 150-300W for both medium and mogul screw base lamps. 300W and 500W, prong base, in portable, flat base or stem-mounting styles. Accessories include mounting plates, hoods, color screens.

Write for Bulletin 2727,
or see your Crouse/Hinds Distributor.

CROUSE HINDS
SYRACUSE NEW YORK

OFFICES: Atlanta Baton Rouge Birmingham Boston Buffalo Charlotte Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Omaha Philadelphia Pittsburgh Portland, Ore. St. Louis St. Paul Salt Lake City San Francisco Seattle Tampa Tulsa Washington
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of free engineering to the public. Ultra Modern Pools, of Wichita, also has revised advertisements appearing in the Kansas Government Journal which offer "complete engineering services available." UMP lacked a professional engineer on its staff.

Iron Ring Ceremony

At the recommendation of the American Society of Mechanical Engineers, the Engineers Council for Professional Development is investigating the possibility of making the Iron Ring a symbol of the North American engineer.

The Iron Ring ceremony, written by Rudyard Kipling, is controlled by seven Canadian wardens. At one time, the Canadians objected to extending the ceremony to non-Canadians, but it is reported unofficially that there is a possibility that a solution can be found.

The original iron rings were from a Canadian bridge that failed, and they were a symbolic reminder to the engineer of his responsibilities. However, the supply of iron from the bridge has been depleted, and the new rings are of stainless steel.

Blatnik Committee Troubles

Representative Blatnik, the investigator of the Federal highway program, has troubles of his own these days. According to Republican members of his committee, Blatnik has opened a political Pandora's Box in Massachusetts and now is quietly trying to get the lid back on without spilling the contents.

The fireworks started with publication of a letter of recommendation for Thomas Worcester from (then) Senator Kennedy to Dwight R. G. Palmer, New Jersey Commissioner of Highways. The letter was written while Thomas Worcester was under indictment for declaring kickbacks as "business expense" on his income tax. It stated that "I am pleased to learn . . . that you have the interest of Thomas Worcester company in mind." (The President's staff says that the letter was written without Kennedy's knowledge, and further, that the staff was unaware of Worcester's legal troubles at that time.) Despite the recommendations, Palmer did not give work to Worcester.

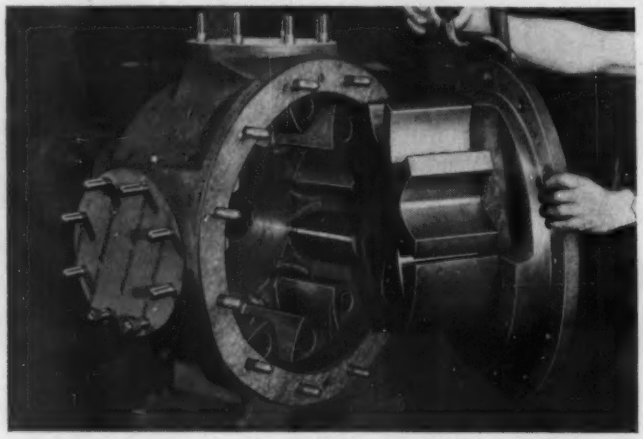
Republican Rep. Gordon H. Scherer, of Ohio, claims that "Our Highway Investigating Committee is controlled lock, stock and barrel by the majority. There are 13 Democrats and 6 Republicans. Such a lopsided majority on an investigating committee is unprecedented in the history of Congress. With this majority, it has exercised iron-clad control over the staff, what [irregularity] is to be investigated, and when.

"Our investigating committee did not hesitate to go into Oklahoma where the grand jury had uncovered some evidence of fraud – an investigation which had political overtones involving a factional fight within the Democratic Party. The present Governor of Oklahoma is the leader of one of the factions which was helped by the hearing. It is significant, or maybe it is merely a coincidence, that his brother is a member of our investigating committee.

"While it has been common knowledge that the U. S. Bureau of Public Roads has been investigating the irregularities in Massachusetts for many months and had stopped payment on all Federal-aid projects in January, and that the Boston newspapers have called attention to the possibility of wrongdoing as early as May, 1960, our Committee has ignored the Massachusetts scandals like the bubonic plague."

Because of the publicity given Palmer's letter, New Jersey is expected to get some Committee attention. On another front, New Mexico currently is being investigated, but no consulting engineers are involved. Rep. Scherer does not expect any Blatnik hearings on Massachusetts to be held during this session of Congress. ▲▲

GEARED TO HANDLE PUMPING PROBLEMS

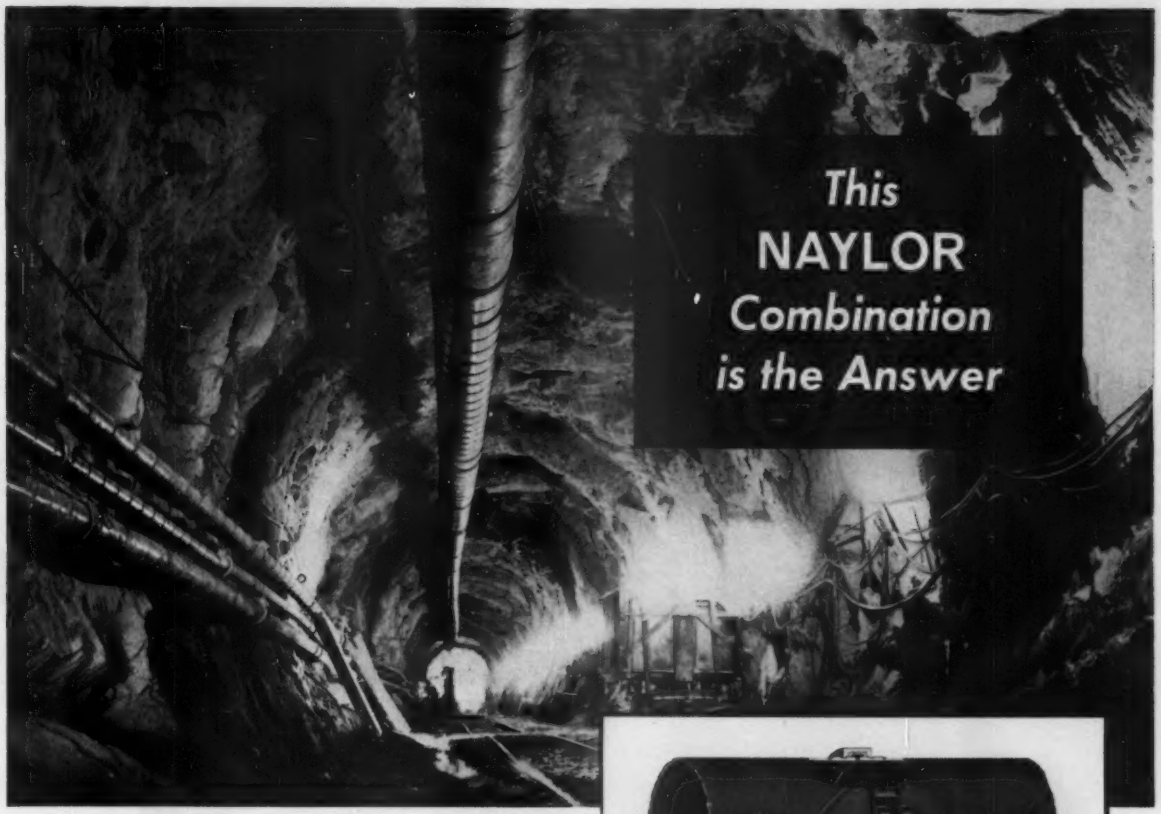


THE VIKING "GEAR-WITHIN-A-GEAR" PUMPING PRINCIPLE helps engineers solve a wide range of pumping problems throughout the world. In the petroleum industry, chemical processing, food processing, meat packing, road building and many other industries, **VIKING PUMPS** handle liquids and semi-solids efficiently and at low cost. And **VIKINGS** pump liquids ranging from thin, liquefied gas to thick, viscous tars. Originated 50 years ago, the **VIKING** pumping principle has been adapted so successfully to so many applications that **VIKING** is now the largest exclusive rotary pump manufacturer in the world.

You men who specify and buy rotary pumps, can select from a complete size range of **VIKING PUMPS**, from 1/2 to 1050 G.P.M. in over 850 catalogued models and thousands of special designs. If you have a pumping problem, tell us . . . and ask for catalog 61SP.

VIKING PUMP COMPANY, Cedar Falls, Iowa, U.S.A. In Canada, it's **"Roto-King" Pumps.** See our catalog in Sweet's Industrial Construction and Plant Engineers File.

How to Simplify PIPING Installations



NAYLOR Wedgelock couplings make a positive connection securely anchored in standard weight grooved ends.

If your job calls for air, water or ventilating lines, you'll be time and money ahead to use NAYLOR Spiralweld pipe and NAYLOR Wedgelock couplings.

This combination simplifies pipe line construction. The pipe is easier to handle, easier to install. Although it is light in weight, there's no sacrifice of strength due to the exclusive lockseamed-spiral-welded structure which creates a stronger, safer pipe.

The Wedgelock coupling saves time and work, too, because it speeds connections. A hammer is the only tool required to connect or disconnect it and lines can be made up with only one side of the pipe in the open.

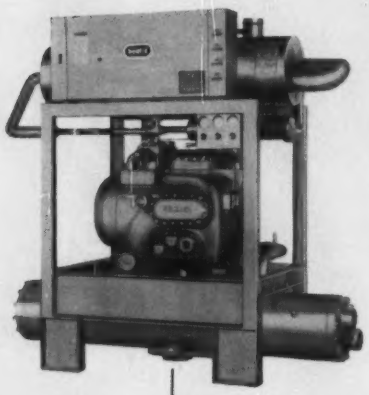
For details on this time-and-money-saving combination, write for Bulletin No. 59

NAYLOR PIPE Company

1276 East 92nd Street, Chicago 19, Illinois

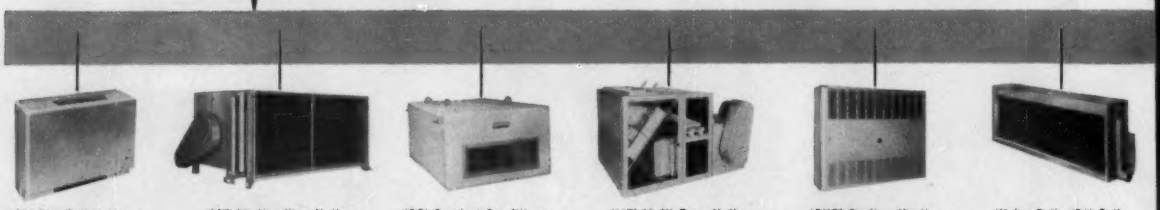
Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

You Can't Beat the



CHILLED WATER AIR CONDITIONING SYSTEMS

Development of packaged water chillers such as the Heat-X 'PC' units has done much to popularize the use of chilled water as a cooling medium for air conditioning. Reasons for the systems' popularity include: dual use of the same piping network for heating and cooling; economy in piping installation costs; simplified, more economical maintenance; variable capacities available within the framework of existing equipment; simpler, personalized temperature control; less stringent code requirements. Heat-X Package Chillers, used in conjunction with many Dunham-Bush units (as illustrated), offer a wide variety of chilled water air conditioning systems.



'CR' Fan-Coil Units. For motels, hotels, residences, institutions

'AH' Air Handling Units. For hospitals, office buildings, bowling alleys, manufacturing areas, supermarkets.

'CC' Comfort Conditioner Units. For office buildings, bowling alleys, light manufacturing, supermarkets, warehouses.

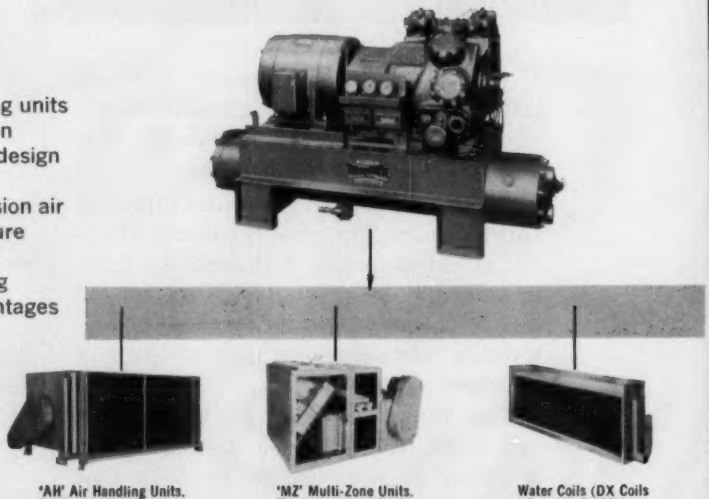
'MZ' Multi-Zone Units. For institutions, theaters, schools, plant offices.

'CHC' Cooling-Heating Wall Unit. For motels, small medical offices.

Water Coils (DX Coils where applicable). For laboratories, industrial air conditioning.

DIRECT EXPANSION AIR CONDITIONING SYSTEMS

Availability of easy-to-install air handling units and compactly constructed refrigeration condensing units such as the modern design Brunner Multi-Drive line has led to a change in thinking about direct expansion air conditioning systems. Wider temperature ranges are available, better control of relative humidity for various processing applications are some of the key advantages of direct expansion systems.



'AH' Air Handling Units. For hospitals, office buildings, bowling alleys, manufacturing areas, supermarkets.

'MZ' Multi-Zone Units. For institutions, theaters, schools, plant offices.

Water Coils (DX Coils where applicable). For laboratories, industrial air conditioning.

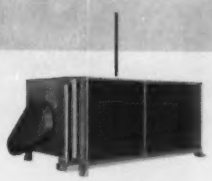
DUNHAM-BUSH

DUNHAM-BUSH Systems

DX AIR COOLED SYSTEMS

Reasons why the Dunham-Bush 'LSCU' (or 'LRCU') Remote Condensing Units have such popular appeal in the air conditioning picture today include: low initial investment, elimination of water supply and disposal problems through use of air cooled condensers, simplified maintenance, flexibility of condenser location and element-proofed construction (permitting outdoor installation with space saving and elimination of noise problems).

'CC' Comfort Conditioner Units. For office buildings, bowling alleys, light manufacturing, supermarkets, warehouses.



'AH' Air Handling Units. For hospitals, office buildings, bowling alleys, manufacturing areas, supermarkets.

Water Coils (DX Coils where applicable). For laboratories, industrial air conditioning.

No need to improvise or compromise when you specify DUNHAM-BUSH. There's a system designed to meet **your** specific needs!

And behind every Dunham-Bush product is the peace of mind reassurance represented by the company's half century of experience in the design and manufacture of quality air conditioning, refrigeration and heating products.

This reassurance underlies the increasing tendency among top consulting engineers to specify products by DUNHAM-BUSH—the company that's on the move . . . setting the pace in **modern** air conditioning.

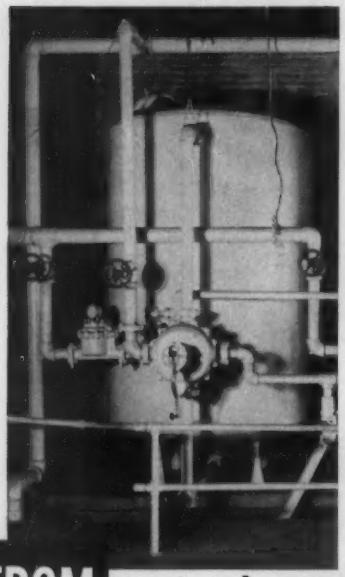
On your next job, contact the DUNHAM-BUSH man . . . you'll find him helpful, experienced, reliable.

DUNHAM-BUSH, INC.

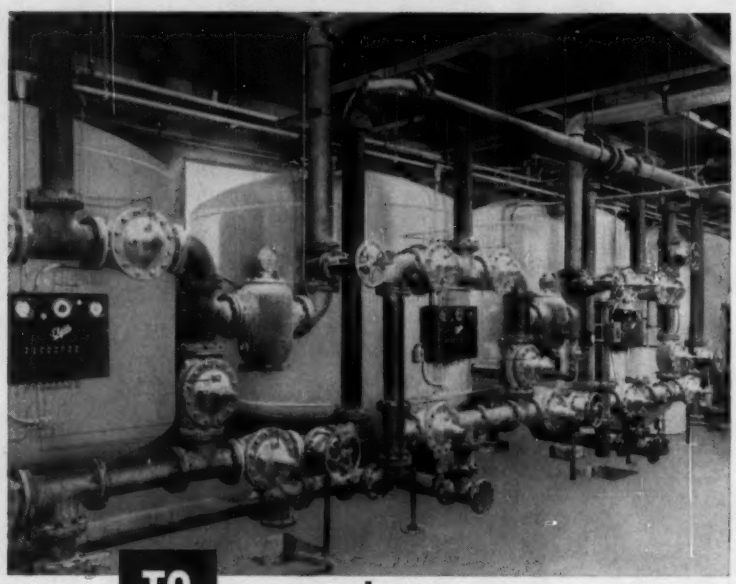
WEST HARTFORD 10, CONNECTICUT, U. S. A.

SALES OFFICES LOCATED IN PRINCIPAL CITIES

Elgin makes it !



FROM a simple zeolite water softener



TO a complex automatic deionizer

-and anything else in between

A firm like Elgin that can give you *anything* you need is obviously the firm that can give you the *right* thing.

Exactly the right thing! . . . the kind of equipment and installation that will give you maximum results at lowest cost . . . the kind of set-up that can only be assured by more than 50 years of intensive specialization in the difficult field of water conditioning.

Yes, a difficult field; a field with too many complexities, too many pitfalls, for the "Johnny-come-lately". And this is just as true of the simplest equipment as of the most complex. The equipment may be simple, but anyone who knows the water conditioning field will tell you that the knowledge going into it is far from simple.

The Elgin installations above are poles apart—in form, in purpose, in cost. But they have one thing in common: Thanks to Elgin know-how, they are the best of their kind. And so is "everything in between" when it's Elgin!

Write for Bulletin 615 covering the scope of Elgin experience. Our nearby representative can put Elgin experience to work on your specific requirements from simplest to most complex.

ELGIN
WATER CONDITIONING
SINCE 1908

ELGIN SOFTENER CORPORATION
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Representatives in Principal Cities • In Canada: G. F. Sterne & Sons Ltd., Brantford

SOFTENERS ION EXCHANGERS FILTERS DEIONIZERS DEALKALIZERS CLARIFIERS DEGASITORS DEAERATING HEATERS

"Quote . . . End Quote"

Engineering Heroes Needed

"The heroes of the world today are not the fellows designing the tail fins and the washing machines. To the sophisticated scientists of the world, the heroes are the Glasers who win Nobel awards in chemistry for the successful completion of an engineering task – the development of a bubble chamber – and the Libbys who win Nobel awards in physics for doing an engineering job – the development of the carbon 14 dating system. To the rest of the people of the world, the heroes are the Doctor Schweitzers and the Doctor Dooleys who are, at great personal sacrifice, helping to lift this underprivileged half of the world up to somewhere closer to where we are here in America today.

"Africa, Indonesia, India, South America – these are the operating areas for the hero engineers of the future. As I have said, problems of these areas will not be comfortable or easy. The jobs involved will not be well-paid ones. No one will ask the engineers to do this work. But I hope that among these half million engineers, there are 5000 who are willing to work and sacrifice and do something truly important for humanity, and to do it with skill and dedication so that the rest of the 500,000 can be called professional men." – Eric A. Walker, president of the *American Society for Engineering Education* in a speech presented at the University of Cincinnati.

On Engineers and Editors

"On the negative side, the editors queried thought that some engineers were reluctant to talk, that when they did talk they were inarticulate in anything but technical terms, that they didn't know what was news, and that they didn't circulate enough at public gatherings. Here is where the professional information man, who usually has had experience on both sides of the fence, can interpret the engineering viewpoint to the layman.

"It has been found that misunderstandings are often a simple matter of human relations. The engineers and reporters in a given town did not really know each other, and as they talked different languages on the brief occasions when they did meet, the misunderstandings grew. But once the two groups were brought together at a luncheon or an inspection trip,

316 STAINLESS STEEL

Welded Bourdon Tube and Pressure Connection

A NEW ADDITION to MERCOID PRESSURE CONTROLS

Series D-41, 243, 541

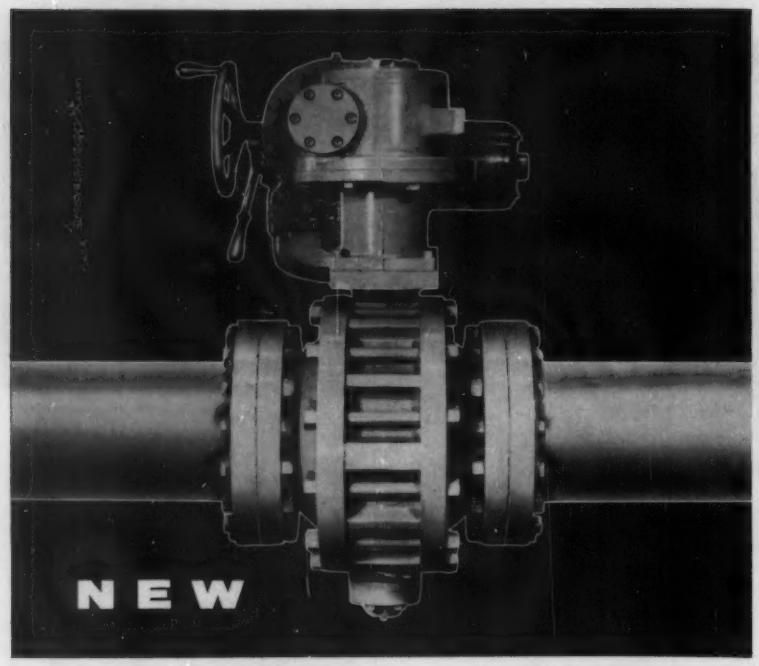
316 stainless steel welded Bourdon tube. ¼" (316) stainless steel pressure connection. Nickel plated mechanism. Outside adjustments. Calibrated dial. Hermetically sealed mercury contact.

Operating ranges: 30" vac.-75 psig; 10-100 psig; 30-400 psig; 75-800 psig. and 100-1000 psig.— with varying differentials and electrical capacity to meet your application.

Three case styles: General Purpose NEMA 1; Weather-Proof NEMA 1A, 2, 3, 4; Explosion-Proof Class 1 Group C, & D; Class 2 Group E, F, G, NEMA 7, 9, 9A.

WRITE FOR BULLETIN 018

THE MERCOID CORPORATION
4211 Belmont Ave., Chicago 41, Ill.



PRATT Rubber Seat Ball Valve

Henry Pratt made the Rubber Seat Butterfly Valve a Waterworks Industry standard.

Now—the Pratt Rubber Seat Ball Valve adds the missing link, the "rubber seat" for Ball and Cone Valve applications. This new Ball Valve is able to offer such operating advantages as:

Lower Operating Torques
Continuous Bubble-tight Sealing
Complete freedom from Binding
Easy "one-man" operation
Less weight
Smaller dimensions
Full Pipeline Area

Available in sizes 10″ through 48″ and in 150 psi and 250 psi designs, the new Pratt Ball Valve extends the desirable characteristics of rubber seating to the higher pressure, higher velocity Waterworks applications.

A most comprehensive catalog is being prepared for Consulting Engineers. It will contain precise data, complete dimensions, illustrations and cross-sections. Write for your copy of
BULLETIN BA-1J

Rubber Seat Ball Valves

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HENRY PRATT®
Creative Engineering for Fluid Systems

the differences disappeared." – Ellis L. Armstrong in a talk at the 40th annual conference of the *Western Association of State Highway Officials.*

We Need These Men

"What is the most valuable asset of a construction organization, whether a public agency or private firm? Machines? Materials? Money?

"These are all important to successful operation, of course. But the vital ingredient is management – and that means men.

"Unfortunately, the construction industry is in danger of losing some of its best men, the leaders of the future.

"Why? Because state boards of examiners refuse to recognize construction as acceptable experience for an engineering license.

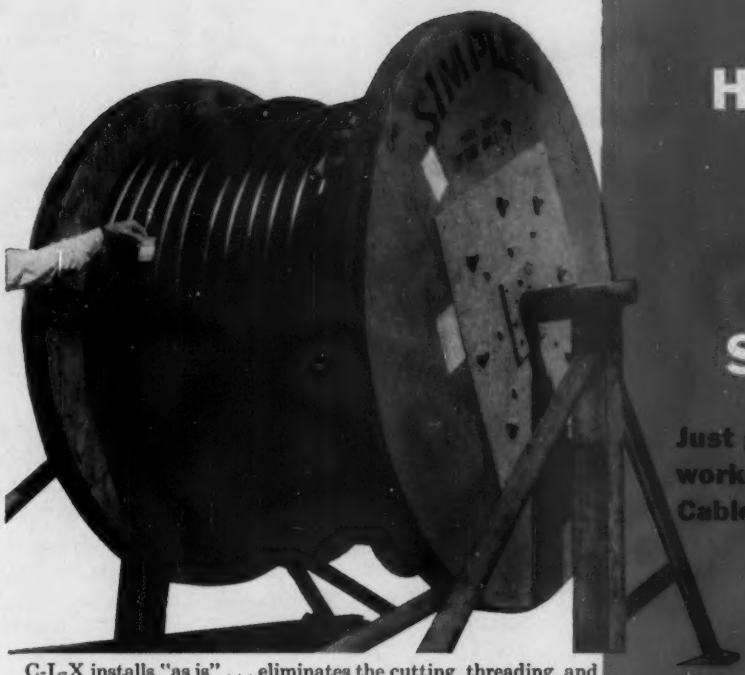
"Licensing of engineers is important to our industry, which like many others, is going through a scientific revolution. We, too, need the best minds working on our problems.

"Men with great talent and ability in engineering want and need professional stature. To get it, they must obtain a professional engineering license. It's our job to help them get it, and see to it that the license can be obtained through practical experience in construction. If we don't, we will lose them.

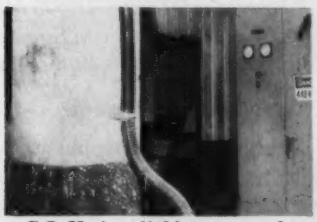
"Many of today's leaders came up 'the hard way.' They learned by doing. That was okay in the past, but the future is more demanding. There's more to learn and our men must learn it faster. Even the old-time, two-fisted contractor recognizes this. He first sends his son to engineering school; then puts him to work on the job.

"Because of the present advanced technology of construction, the public often demands the analysis and final judgment of a professional licensed engineer on many phases of the work.

"You want these men inside, not outside your organization. Many of the state boards, though, say a



C-L-X installs "as is" . . . eliminates the cutting, threading, and pulling operations necessary with conventional duct or conduit.

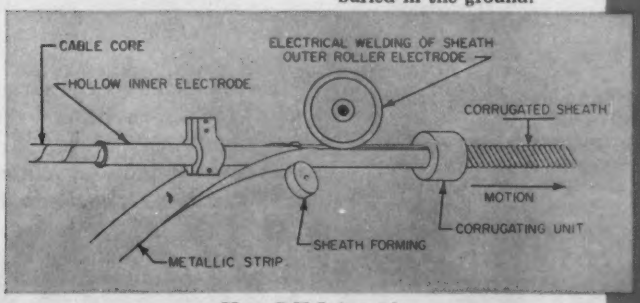


C-L-X is pliable . . . can be handled smoothly on a standard size reel.

C-L-X is easily trained anywhere, in continuous, long-length runs.

C-L-X installs without the need for benders, sand, elbows, or similar fittings.

C-L-X is versatile. It can be installed with clamps, in trays or ladders, or directly buried in the ground.



How C-X-L is made.

HOW MUCH MONEY COULD C-L-X SAVE YOU?

Just glance at these time-and-work-saving features of C-L-X Cable Systems by SIMPLEX.

You'll see how easily this packaged *combination* of cable and pliable, impervious metallic sheath installs. You'll see why it cuts installation cost to a fraction of that required for conventional cable and duct. Then *find out* how much money today's easiest-to-install cable system can save you.

C-L-X is available with plastic-jacketed sheaths of steel and with sheaths of aluminum, bronze, or copper — with or without plastic jacket. It's the choice of chemical plants, oil refineries, paper mills, utilities, industrial plants — wherever severe environmental conditions exist. Write today for your free, illustrated brochure on C-L-X.

Simplex
WIRE & CABLE CO.
Cambridge, Massachusetts • Newington, N.H.

This WHEEL

MAKES LEHIGH I. E. INDUSTRIAL FANS IDEAL FOR TOUGH INDUSTRIAL EXHAUST APPLICATIONS

Handles dust-laden air and gases, paper shavings and the like without clogging

Lehigh Industrial I.E. Fans . . . featuring heavy duty, unique channel construction, all-welded mild steel wheels of the long shaving design . . . solve difficult exhaust problems because of their non-clogging characteristics. They incorporate a universal housing, which permits rotation and discharge to be modified to facilitate variable field conditions.

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"See Chemical Engineering Catalog for details and specifications."

man can't get the professional experience he needs in your company. You and I know that's not true. Now, we have to convince the licensing boards.

"Working with your state associations, help the members of your state board to understand the nature of your business. It should be relatively easy to prove to them that a man obtains valued engineering experience in construction. Certainly, the estimating, bidding, planning, and directing of a major construction operation is every bit as demanding of engineering skill as is the design of a project. From experience on both sides of the fence, I know construction often demands greater ability. And as our part of this educational program, we are sending this editorial to all state boards. You can do yours by supporting the activities of AGC, ARBA, ASCE, and other groups advancing the interests of engineers in construction. To repeat: we need these men." — Michael A. Spronck, editor of *Construction Equipment.*

A Matter of Temperament?

"I believe that temperament is a basic cause for some of the differences and misunderstandings between the two design professions. Generally, the architect has a greater artistic sense, whereas the engineer has a greater utilitarian sense. Consequently, the architect is primarily interested in creating a harmonious blend of materials and space usage as an esthetic whole, while the engineer is interested in the application of materials and equipment to create systems — be they mechanical, structural, or any other — all to function as simply as possible within a space usage framework.

"I believe engineers can do just as good a job — if not better — than architects in assuming over-all responsibility for projects. Witness the fact that so many engineers advance into management.

"I feel it is vital for the success of any project that the design team

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The Weil-McLain Research and Engineering Laboratory is evidence of the Company's belief that only through constant study and flexibility of thinking can it continue to hold its position as a manufacturer of highest quality boilers and radiation. Here research and experiment are translated into better product...so that Weil-McLain equipment can always be installed with complete confidence.

Practical field help is also provided. Questions relating to proper system design, product selection, installation and servicing of Weil-McLain heating equipment are handled promptly by the Technical Services Department. In the Weil-McLain School of Better Heating, classes in the design and installation of modern hydronic heating systems are regularly conducted for contractors and wholesalers.

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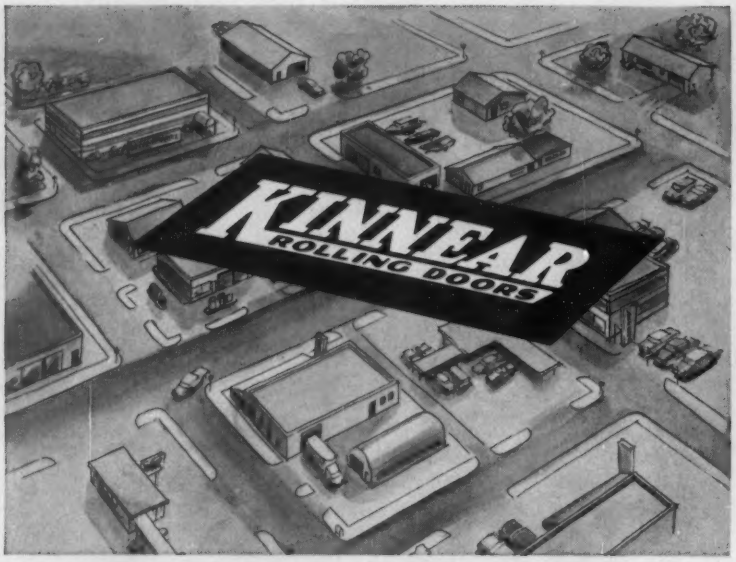

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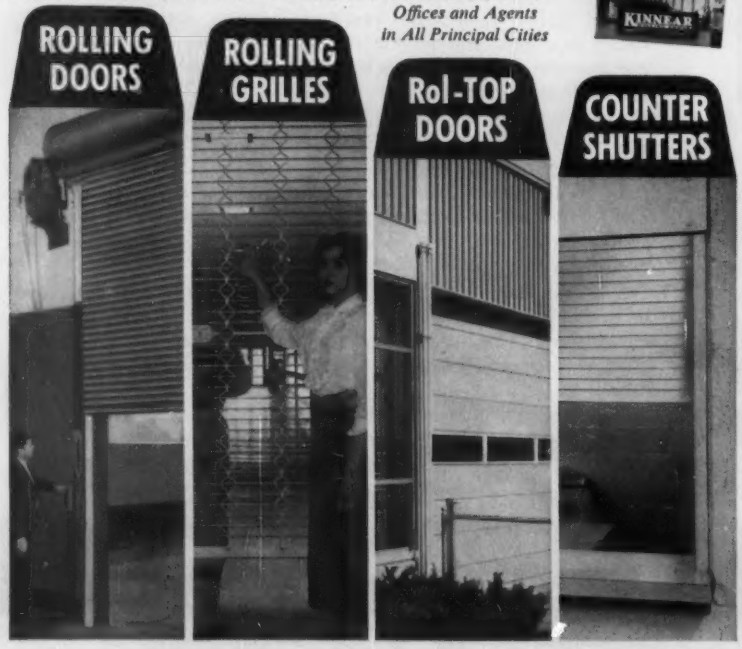


of engineers and architects be a well integrated group composed not only of individuals of skill and knowledge, but individuals compatible professionally and personally – individuals who have a mutual regard for each other – individuals who are sensitive to the needs of fellow team members.

"I strongly feel that both design professions, engineers and architects, should:

1. Recognize their common heritage and allied backgrounds
2. Recognize the architect's deep appreciation of esthetics
3. Recognize the engineer's desire for simple applications of systems comprised of materials and equipment
4. Recognize [that] the analytical and methodical training of the engineer fits them to be managers.
5. Put aside petty jealousies and differences
6. Work together, nationally in the area of broad policies and locally in the area of specifics.

"Such a program of action would develop an atmosphere of mutual understanding, confidence, and collaboration, all to the benefit of the people we, the design professions, serve." – Henry A. Naylor, Jr., P.E., in the May 1961 *AIA Journal.*

Paying for the Highways

"Everybody likes to drive on a fine, modern highway, but nobody wants to pay for it. President Kennedy, who delivered to Congress on February 28 an admirable message on pay-as-we-go financing, has received from the House Ways and Means Committee a reply that reveals the habitual Congressional reluctance to make the voter pay for what he enjoys in good roads.

"The committee did renew the 4-cent-a-gallon tax on gasoline and diesel fuel, instead of letting the rate revert to 3 cents on July 1. But in rejecting the Kennedy recommendation that the diesel-fuel tax rise to 7 cents a gallon, the committee yielded to the trucking lobby. It also failed to increase the

How sewage pumping is made easier with an Ampli-Speed magnetic drive

by Warren J. Birgel
Electrical Engineer
Electric Machinery Mfg. Company

W. J. Birgel

For years a common method of varying the speed of sewage pumps to match flow rate was by use of wound-rotor induction motors. In recent times, however, a new electrical device has won wide acceptance for its efficient speed control capabilities. This device is the eddy-current slip coupling, or magnetic drive.

With a magnetic drive installed between a constant-speed motor and the pump, pumping speed is adjusted with a simple potentiometer control.

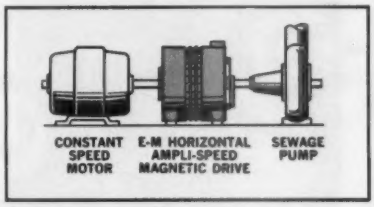
The constant speed electric motor-magnetic drive combination provides an all-electric system that offers distinct advantages in planning new pumping installations or in redesigning older ones. Here's how:

Smaller Wet Well. With a magnetic drive on one or more pumps, the wet well or grit chamber can be made 25-35% smaller because it must handle only average flow, rather than maximum flow. With constant-speed drivers, the wet well must be designed for maximum flow.

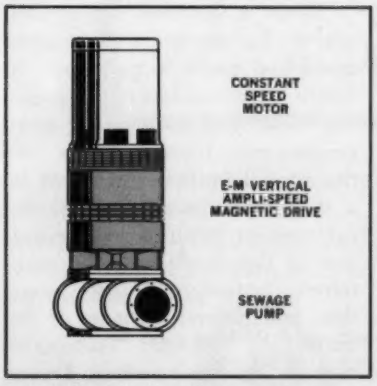
Improved Plant Performance. With adjustable speed pumping, sewage feed through the plant is more even . . . the surging associated with constant-speed pumping is eliminated. In some cases, this makes it possible to avoid kilowatt demand penalties.

Less Pump Wear. With constant-speed pumps, the sudden-start surging of sand and gravel into the pump can often damage the impeller and casing rings. With a suitable automatic control system and magnetic drive, grit does not settle out because pumping is continuous. Abrasives move into the pump in suspension, with far less chance of pump damage.

Permits Plant Expansion. Expansion flexibility is inherent in magnetic drive pumping. The automatic control system can be easily enlarged to include other pumps in sequence.



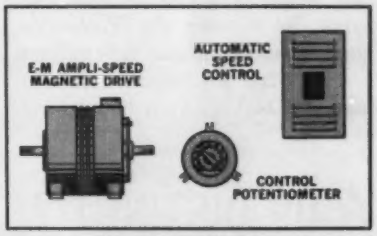
HORIZONTAL INSTALLATION is compact. And air-cooled Ampli-Speed requires no complex cooling system, may be installed and treated like a motor. E-M builds Ampli-Speed Drives to fit all pumping applications.



VERTICAL INSTALLATION requires no more floor space than constant-speed motor. Magnetic drive becomes integral with motor. E-M builds vertical Ampli-Speed Drives in a wide range of ratings.

Air-Cooled. Can be installed and serviced like an air-cooled motor.

Easy Maintenance. No heavy brush currents . . . no electrolytes.



SIMPLICITY OF AMPLI-SPEED installations allows sewage plant operators to derive maximum benefit from adjustable-speed pumping systems. Simple control components keep maintenance to a minimum.

Ampli-Speed is available for either vertical or horizontal installations, with wide range of input speeds. And E-M has designed applications through 800 hp.

Call your nearest E-M Sales Engineer now for qualified assistance in planning a really efficient sewage pumping system for your client. Or write to Electric Machinery Mfg. Company, Minneapolis 13, Minn.

Ampli-Speed Gives You Precise Adjustable-Speed Pumping

E-M specialists, through extensive research into sewage pumping requirements, have developed a highly efficient, precisely engineered magnetic drive called Ampli-Speed. Check these Ampli-Speed features:

Simple Control. For manual control, operator adjusts potentiometer krob. Quickly adapts to automatic liquid level control systems.

Precise, Stepless Speed. Output speed held to close tolerances. Provides smooth, stepless speed changes.

Compact Installation. Ampli-Speed requires no more floor space than that required by drive motor on vertical installation, very little more on horizontal installation.

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Turbine-Driven A-C Generators • Motor Controls • Generator Switchgear

highway-use tax for trucks and buses weighing over 26,000 pounds nearly as much as the President held necessary.

"While ostensibly keeping construction of the 41,000-mile interstate highway system on schedule for completion in 1972, the Ways and Means plan violates sound finance by tapping the Treasury's general fund by about $150 million a year. What this means is that the highway budget is not balanced honestly; it is made to appear in balance by reaching into the general taxpayer's pocket. Congress, by diverting badly needed funds from the general fund, will, as the President said, 'be deliberately unbalancing the budget.' The President also noted that borrowing for construction would hamper the government's efforts to reduce long-term interest rates.

"The diesel-fuel tax increase the President sought would have brought in $108 million. Millions of dollars from the larger increase of the truck-use tax than the committee granted would likewise have more fairly assessed the trucking industry for the highways it does business on. But the committee heeded the industry's dire but implausible warnings of financial 'disaster,' and complaints from the Teamsters Union about the 'monopolistic power' of the railroads — those same 'monopolistic' railroads that are having to be saved by government from bankruptcy partly because of competition of tax-subsidized highways and airports.

"The Ways and Means Committee has fallen far short of what the facts require for sound highway financing. Congress will have to improve the committee's timorous product." — from an editorial in *The New York Times,* Wednesday, April 26, 1961.

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"The Series 60"...refreshing new styling with the durable beauty of gleaming vitreous china, permanently in good taste. All are wall-hung models, based on the same appealing design. Choose the model that best fits your plans...or choose several to complement each other in varied locations. Sanitation? Only HAWS has the exclusive M fountain head...raised, shielded, anti-squirt angle stream. Automatic flow control, too. Get detailed specs from HAWS. Write today.

Model 62-GF: HAWS glass filler faucet installed on back of Model 62, for double-duty convenience.

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The Preservation of "Downtown"

"The doubling or tripling of downtown parking facilities and the expenditures of millions of dollars for new automobile freeways have, in many cities, actually resulted in a decrease in the number of people entering the downtown area. And for the downtown merchant, it is people who count, not vehicles.

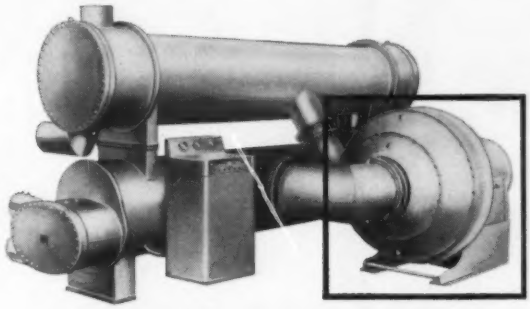
"With only three to four percent of the vehicles on the street, transit today is still carrying from 40 to 60 percent, on the average, of the people who enter and leave downtown areas.

"When it becomes the general practice for downtown department stores and banks to participate in transit fare validation programs, the major goal of inducing more people with fewer vehicles into the central business area will be a step closer to reality, and the ever-present threat of decentralization of downtowns will be minimized." — Joseph W. Arnn, president and general manager of the Springfield (Illinois) Transportation Co. to the *American Transit Association.* ▲▲

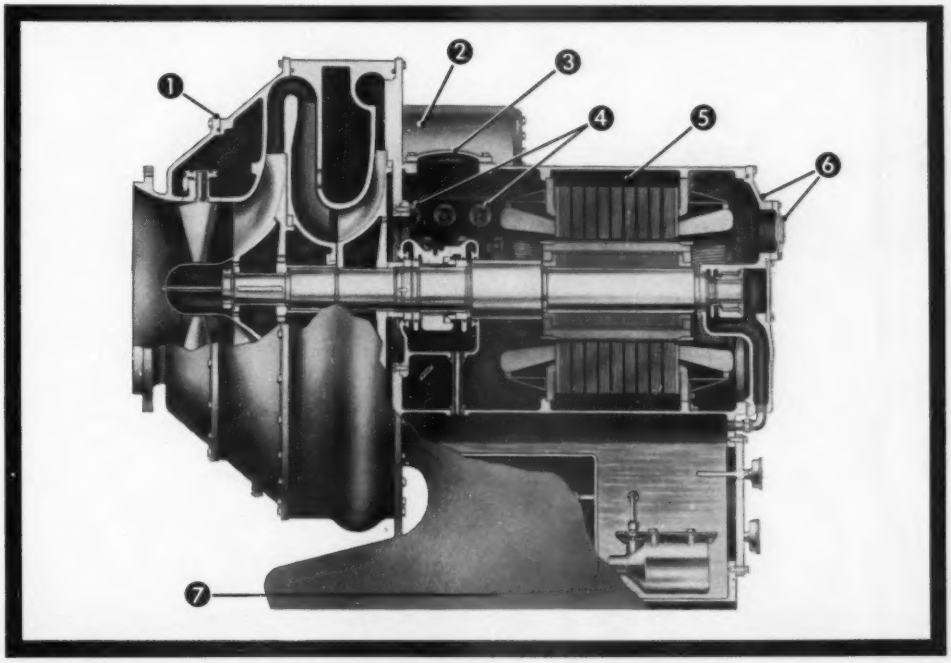
THE PROOF'S INSIDE!

Carrier Hermetic Centrifugal Liquid Chilling Packages Are Designed and Manufactured for Superior Performance!

Whether the job entails air conditioning or process refrigeration, here are some of the many features of Carrier Hermetic Centrifugals that assure your clients of maximum efficiency and lowest maintenance costs. When you specify Carrier, you can be sure of highest quality and dependable performance. For complete information about Carrier Hermetic Centrifugals, write Carrier Air Conditioning Company, Syracuse 1, N. Y. In Canada: Carrier Air Conditioning Ltd., Toronto 14.



Capacities from 100 to 2000 tons



1. Metal to metal construction with modern O-ring gaskets assures gas tightness.

2. Cool weather compensator permits the machine to operate continuously at low loads in cool weather without condenser water by-pass.

3. Access to both babbitted bearings for inspection or routine service is simple and direct.

4. Six terminals are provided for star-delta wiring of motor for low starting current.

5. Motor is kept uniformly cool by flow of dry refrigerant gas in contact with and around stator and rotor.

6. Motor stator may be withdrawn after removal of the end cover, without dismantling the compressor. Easy access to motor for inspection.

7. No heavy concrete base or foundation required; two steel sole plates with leveling jack screws and moulded grooved neoprene isolation pads permit easy installation directly on floor.

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Order Youngstown seamless 2⅜" O.D. to 14" O.D. Get it with ends plain, beveled, threaded and coupled. Try exclusive Yoloy, Youngstown's high strength steel that is up to 6 times more corrosion resistant. Get the size, grade and kind of quality Youngstown steel pipe you need, delivered when you need it, from over 900 reliable pipe distributors.

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Youngstown – growing force in steel

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The Youngstown Sheet and Tube Company, Youngstown, Ohio

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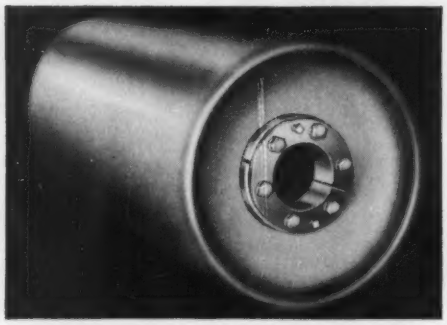

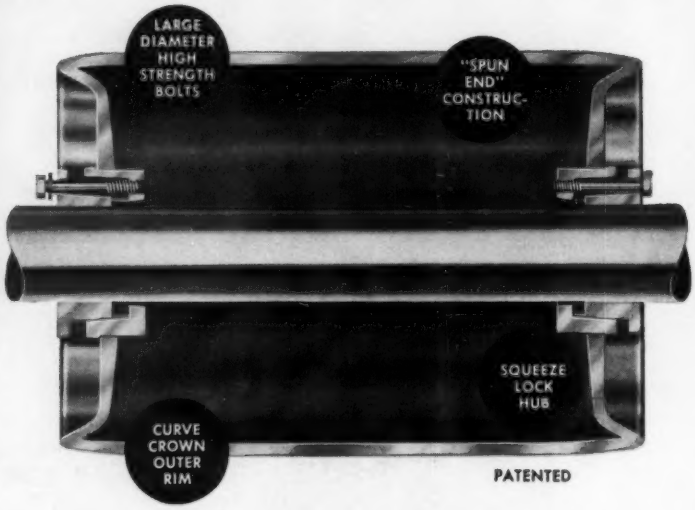

"SPUN END" CONSTRUCTION

Exclusive, one-piece, all steel "Spun End" construction eliminates weldments in areas of high stress concentration, a major source of fatigue, warping and trouble. "Spun End" construction allows the placement of maximum metal thickness at end plate bore reducing unit pressures of radial loads while providing thin plate flexibility to accommodate shaft deflections.

CURVE CROWN DESIGN

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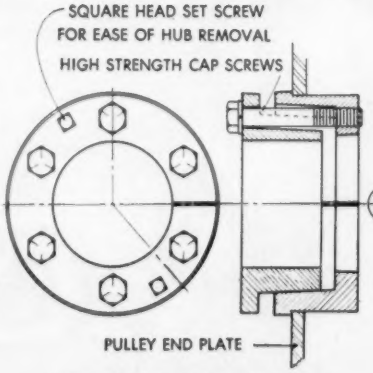
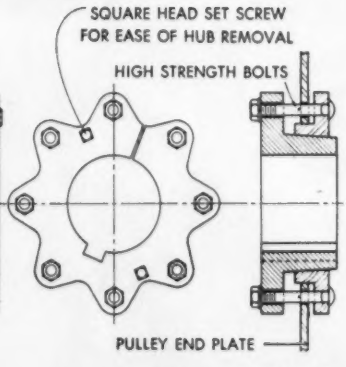
SQUEEZE LOCK HUB

Revolutionary SQUEEZE LOCK Hub design effectively transfers loads from rim to hub and from hub to shaft. Hub design provides gripping power for full torque transmission without the use of keyways and eliminates distorting loads against pulley "Spun End." The SQUEEZE LOCK Hub accomplishes this by exerting equal locking forces in two directions — to both shaft and pulley end plates — through a self contained hub. The outer bushing expands against pulley end plate, while the inner bushing contracts against shaft by tightening six large diameter, high strength bolts.

OUT PERFORMS ANY PULLEY EVER BUILT



SQUEEZE LOCK Hub furnished with STANDARD CURVE CROWN "SPUN END." Pulleys from 1" thru 4½" bore.



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WRITE FOR BULLETIN 1160

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MARJORIE ODEN
Eastern Editor

The CSI on Specifications

Field Notes

IT SEEMS that any number can play the game of writing specifications. At the recent convention of the Construction Specifications Institute, manufacturers' representatives, contractors, architects, and an occasional engineer made suggestions on the preparation of specifications. Even Philip Will Jr., president of AIA, fell into the spirit, describing architecture as a team sport.

If the program left something to be desired by its stress on generalities ("Let's not discuss 'or equal' at this time. It's too involved."), CSI still deserves a loud round of applause for two major documents distributed for the first time at the meeting. After what must have been a formidable amount of committee work, CSI unveiled "A Manual of Practice for Specification Writing Methods" and a sample outline of "Construction Documents for General Work for an Office Building." It was announced further that a committee study on the use of trade names and "or equal" in specifications will be released later this year.

The Manual of Practice

Although getting down to such nuts and bolts topics as how to bind specifications, the Manual is presented only as a guide. As the committee explained:

"This is not an easy task, primarily because, nationally, it has not been done before. We have seen a dozen or so attempts by various regional groups to develop such formats and arrangements. To attempt to superimpose upon these regional groups another and different system of arrangement is, naturally, going to meet with opposition from these groups."

The committee pointed out that the Manual still is tentative, and asked for comments, with a plea that the suggestions be confined to "the principles we have laid down, rather than the details."

In a study of sample specifications, the committee found that "Undoubtedly, the worst parts of any set of construction documents are all those parts that appear ahead of the technical or trade sections of the specifications; i.e., the so-called nontechnical part.

"Whether we are looking at Invitation to Bid, Instructions to Bidders, Contract Forms, or even General Conditions and its multitude of complex modifications in the Supplemental General Conditions, we see the same sad picture of confusion and mixup. We see hopelessly involved, complicated, and impractical examples of writing in these nontechnical parts. We see intricate legal language and repetitions galore that are sometimes contradictory. We see cumbersome mixups or overlappings of the various parts that show no evidence of any understanding of the basic principles that should separate one part from another. We see terms,

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titles, and names that seem deliberately to confuse. We see practices which only the very best practitioners can understand, and which they themselves know are terrible; but the whole system is such an immense bulwark of immobile obstacles that they know they cannot attempt to buck it."

Suggested Improvement

The Manual takes each portion of specification writing, and gives a thorough discussion of what should and should not be included, the best arrangement for clarity, and other details for improvement. Some of the more helpful suggestions included:

"There is an inclination among many specification writers — in an effort to make things look orderly — to give numbers to everything. We would say: 'Stay out of the numbers racket.' We only need to number things where there are very many of them. This is, by and large, specification sections only. Avoid artificial systems; above all, avoid the Dewey decimal system. This provides endless opportunities for typographical errors, aside from causing tremendous extra work to very little avail.

"Specifications should be divided into 'Sections;' each one of these should cover the work of one subcontractor or part of such a subcontract, but never the work of two subcontractors." (In states with licensing regulations, don't put men working under different licenses in the same section. It was pointed out that this rule cannot always be followed, but is advisable when practical.)

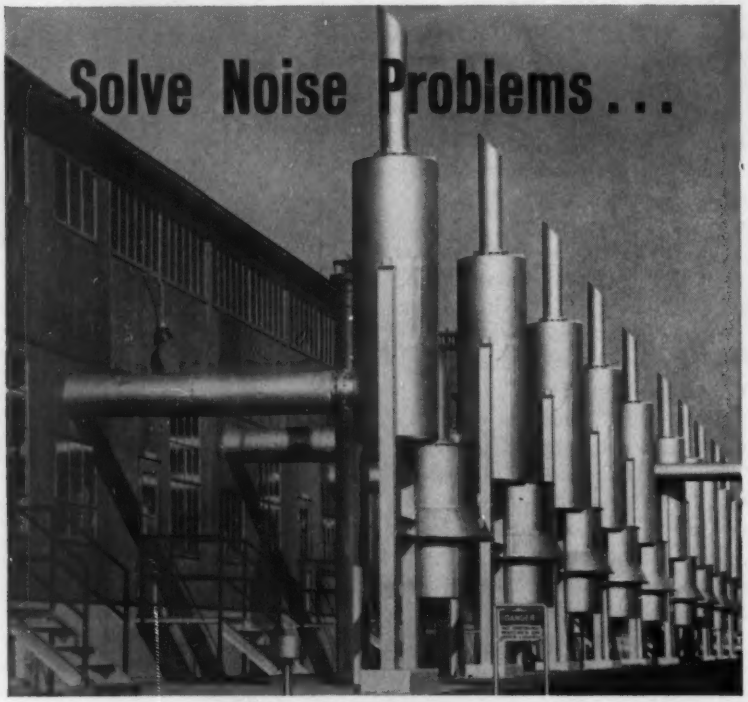
"A contract should preferably be stated in writing, fully and completely, stating the meeting of minds of the two contracting parties; . . . This would seem to be elementary. However, it is known that sometimes the Invitation to Bid is done over the telephone or by oral communication with a selected group of bidders. This is dangerous practice.

"A good specification contains the fewest words that can be used to complete the description and make sense." (An excerpt from one spec was given, with a 192-word sentence.)

To point out the importance of conciseness, the Manual also quotes a court decision: "The meaning of a contract must be ascertained from the words used therein, and if the language is ambiguous, then the intent of the parties must be ascertained from their actions."

Spec writers were cautioned against the use of weasel phrases such as "In the opinion of the Engineer or Architect; To the satisfaction of the Engineer or Architect; As directed by the Engineer or Architect; At the discretion of the Engineer or Architect; Approved by the Engineer or Approved by the Architect.

"Fewer engineers and architects would use the 'satisfaction' phrases



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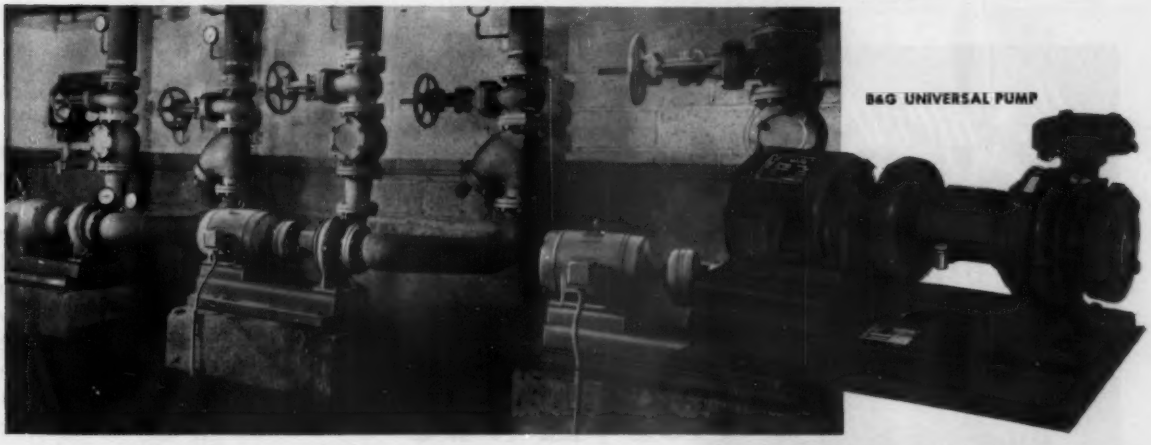

Battery of B&G Universal primary circulating pumps

At Green Acres Garden Apartments, Valley Stream, N.Y., 61 two-story units containing 294 apartments are heated by a B&G *Hydro-Flo* forced hot water baseboard system. The system is designed for primary and secondary pumping, a method conceived and developed by B&G engineers.

Where multiple buildings or multiple zones are to be heated with circulated water this pumping method *reduces the pump horsepower required, improves heat control and saves fuel.*

A typical system consists of a primary main, continuously circulated by a B&G Universal Pump, with smaller B&G Pumps drawing on the primary main to supply separate heating zones. Each zone pump is under individual thermostatic control, so that each zone can be supplied with exactly the amount of heat required by its function or exposure.

The Green Acres installation has six secondary heating zones and six domestic water zones.

Photo shows secondary heating pump, domestic water secondary pump and domestic water recirculating pump.

B&G SERIES 1522 PUMP

Send for booklet on B&G Primary and Secondary Pumping

BELL & GOSSETT
COMPANY
Dept. GS-70, Morton Grove, Illinois

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if they realized that the unabridged dictionary definition of 'satisfaction' describes it as a personal feeling of pleasure or comfort generated by an award, or some emolument.

"They (the phrases) are used as substitutes for proper laboratory tests of materials or products, or as the way to 'pass the buck' from the office to the field, when a designer is not sure what quality or characteristic should be specified." Specification writers also were cautioned in the use of commercially sponsored specifications.

"These are indispensable sources of information but they must be carefully screened to avoid unwanted or unnecessary restrictions. Even those 'suggested' specifications that do not mention a product by brand name may contain unessential features that are available only from the sponsor. Often these specifications are written by an advertising expert rather than an experienced construction specification writer and consequently need general editing."

The Architect's View

Will, in his speech at the meeting, mentioned that AIA once regarded CSI as "a new puppy in the block," but now realizes the block is big enough for both.

"We can be grateful for one great, new overwhelming fact. For the first time in history, architectural and engineering design are absolutely essential elements in the planning and building process . . . At the turn of the century, such a statement simply could not have been made.

"I know of no law which says that our traditional ways must be followed; that architects, planners, or engineers must survive in private practice; that combines of vast capital resources cannot hire the salaried hands and package the job of creating whole cities; or that government cannot create more bureaus to provide whatever services and products an impatient public may demand.

"Make no mistake about it; the building industry in general and the design professions in particular are about to be tested as never before . . . In this new world of technological and social change, this is not the time for inter-professional jurisdictional squabbles.

". . . No matter how many tears we shed or how we may sentimentalize the all-purpose genius or the one man office, architecture has become a team sport. When we fail to field a full team we simply lose the game. In fact, we disqualify ourselves even before the game begins. Remember that non-professional enterprise bears no burden of sentimental nostalgia, but seeks its profits with a cold and realistic approach.

"The small office is not about to be abolished; nor would we have it so. But if, as I believe, the great architecture of our times is the building and re-building of our

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The same engineering know-how that goes into the manufacture of world-famous Rocker-Glo switches, makes Turnlok wiring devices supreme in their field, too. On heavy duty devices or residential, the P&S mark is your guarantee of the best your money can buy.
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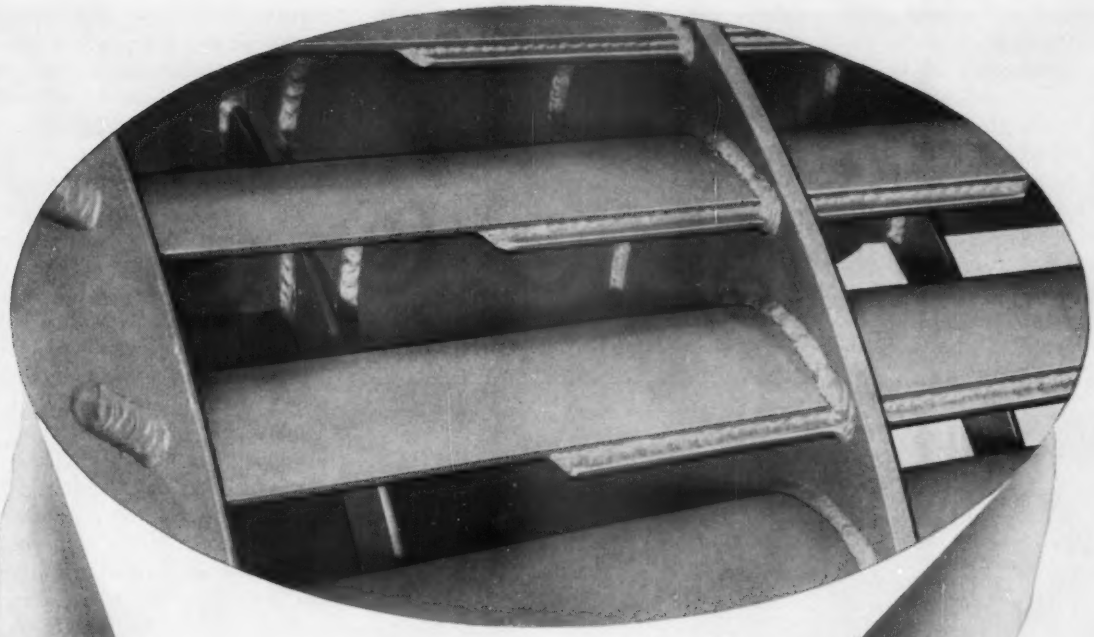
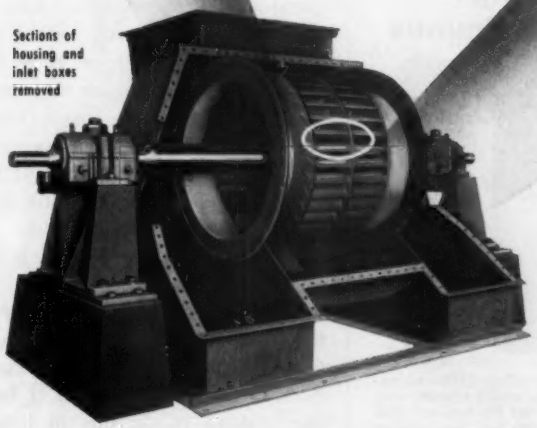


RIGHT WHERE THEY BELONG . . .

wearing plates on the FACE of the blades



Sections of housing and inlet boxes removed

Here's another feature you get only from Clarage. The Type DN Dynacurve induced draft fan, when equipped with wearing plates, has these abrasion-resisting steel plates welded to the *face* of the wheel blades.

Result: *extra* service life.

Don't settle for less. Choose the Clarage Dynacurve fan with its rugged wheel of 36 radially deep blades . . . minimum floor space and height requirements . . . bolted scroll liners for easy replacement . . . and numerous other distinctive features.

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Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

cities, then the small office can do little but fiddle with the fringes . . . For better or for worse, the great and important designs will be executed by the large offices which recognize the scope of the job to be done, build their teams, and play the great game with vision and vigor.

"Nor, because they are part of the team, will there by any less need for creative genius. Quite the contrary. The need for leadership, for professional statesmanship, exists as never before."

Other Opinions

During a panel discussion, Michael Garber, consulting engineer from Philadelphia, pointed out that no mechanical system is designed so perfectly that it does not need testing, and too often the contractors either cannot or will not test the machinery properly. He suggested that both engineers and contractors learn more about proper testing or use independent laboratory tests. "I also would like furture standards to include durability ratings as well as initial performance."

James Nielson, a materials supplier, suggested manufacturers give more uniform descriptions of products in order to make life easier for the specification writer.

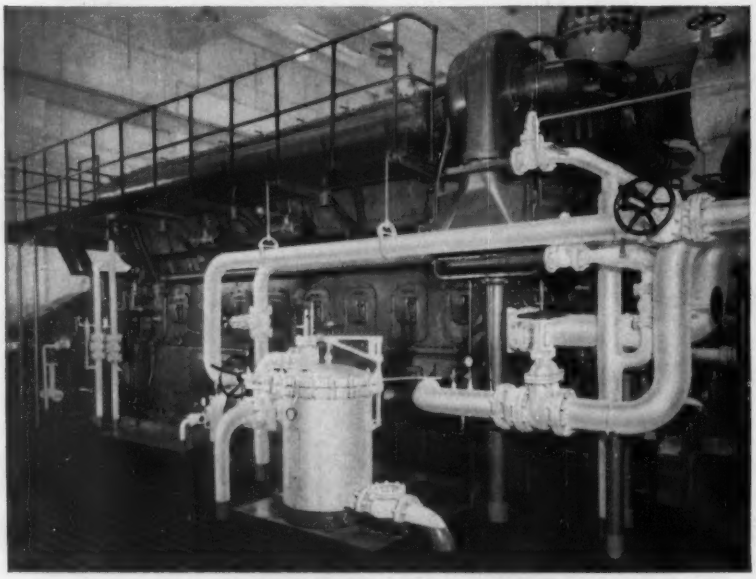
A general contractor, Jack Milne, pointed out the hardships encountered by a contractor's estimator, who often has only 48 hours in which to familiarize himself with a job and prepare an estimate. In estimating the time it will take to complete a project, points most often overlooked by a contractor are the time it takes to negotiate a contract and get approval, and the possibilities of bad weather.

Herbert Schatzman, who is in charge of specifications and estimating at Praeger-Kavanaugh, liked the proposed manual. "What is included in the manual is excellent, but I hope specifications writers will not copy the manual verbatim. It would destroy initiative, as does misuse of standards.

"I agree with CSI speakers that the area in which most specifications writers could improve their final specs is in office coordination. For instance, a specifier should be given all correspondence with a client before he starts writing the specs on a project. Even if he has talked with the designer extensively, a designer may forget small points of a previous agreement.

"Although the manual might appear to oversimplify, I think it is worth any consultant's time to study it thoroughly. No spec is too good to be improved."

As to the meeting, Schatzman would like to see the discussions get down to issues instead of skirting the fringes. "However, I hear they intend to do this in future conventions, as soon as they have established basic objectives. I am looking forward to seeing what the national group has to say about the 'or equal' problem." ▲▲



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Continuous operating, heavy-duty, pipe line compressor equipment demands completely filtered lube oil to ensure maintenance-free, long-life . . . For this type of service Nugent Laminated Disc Type Full Flow Filters are ideal.

Nugent Fig. 1555 filters filter all the lube oil in circulation, every cycle . . . dirt and foreign solids, as small as 2 microns, are removed quickly as they enter the oil, before they can cause excessive wear . . . yet, detergent additives are unaffected.

Shown above is a Nugent Fig. 1555 size 4L12, one of sixty Nugent filters installed for Columbia Gulf Transmission Company of Houston, Texas. These filters protect: natural gas engines, speed increaser gears, and centrifugal compressors in five remote controlled automatic pipeline stations.

The fine record of efficiency established by these stations is one more example of how Nugent Filters can be used to lengthen the service life of your valuable equipment . . . reduce downtime . . . cut maintenance cost. Let us show you how. Write for information today.

Nugent Fig. 1555—4L recharge, before and after use. Expected life between 2000 and 2500 hrs. Used charge retains approximately 19½ lbs. of foreign matter.

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LOWER PHOTO: These two Clyde Whirleys at the Port of Stockton, Calif., can handle heavy cargo working either in tandem or singly.

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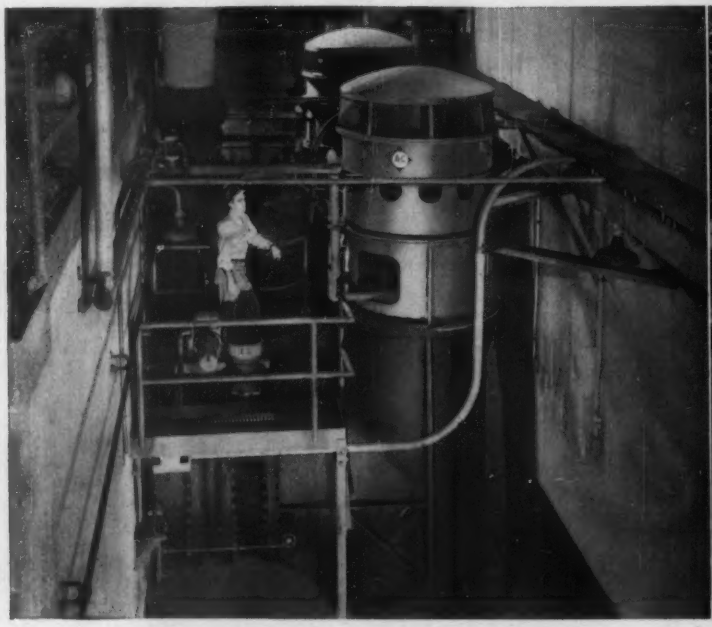
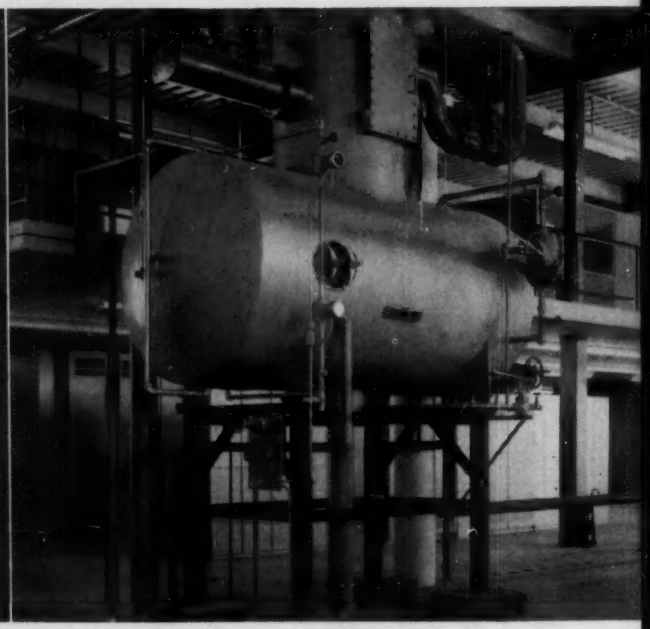
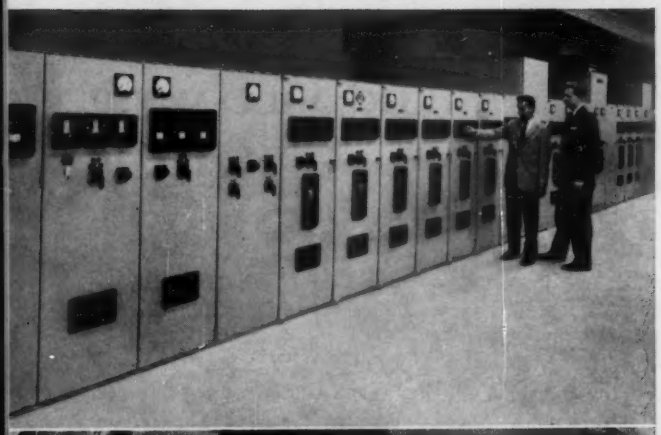


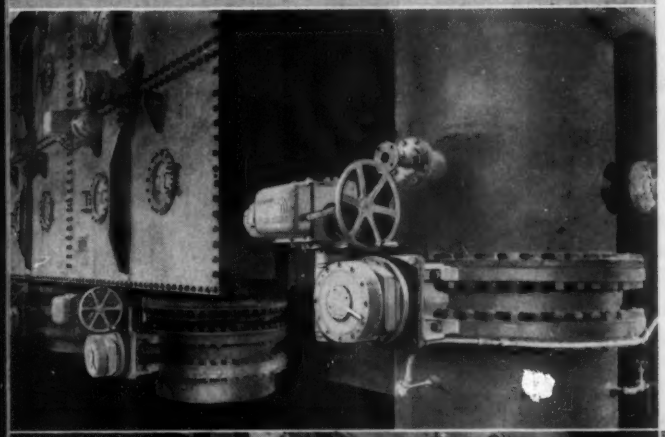


Rugged construction for continuous operation at highest possible efficiencies — yours with these condenser circulating water pumps and vertical induction motors. All pumps are tested at rated head and capacity to assure guaranteed performance. Available in a wide variety of materials to meet your installation needs. *Super-Seal* motors, with *Silco-Flex* insulation, assure complete reliability for outdoor installations and areas with high humidity or contaminated atmospheres.

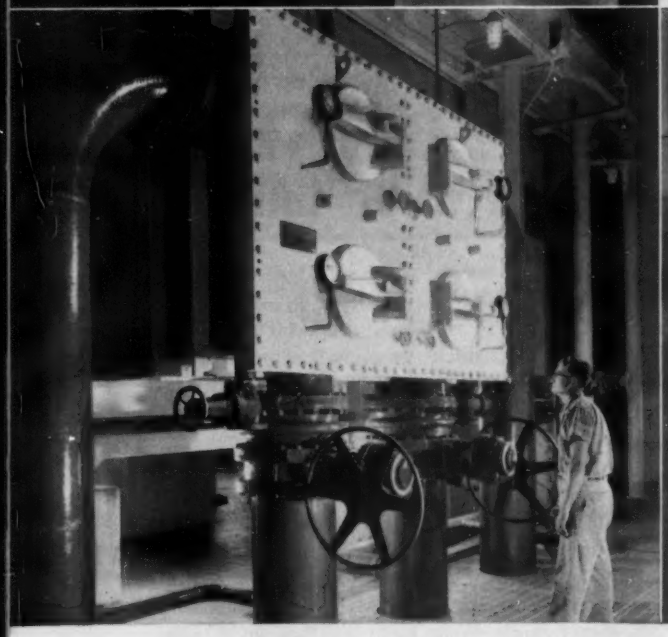
Stainless steel "scorns" corrosion — It's standard with all Allis-Chalmers tray-type deaerator internals. This 90,000 lbs. per hour "package" unit removes oxygen and other corrosive gases besides heating boiler feedwater. Heating and distributing tray design provides greater spillage edge — extra-efficient air separating trays remove more oxygen and gases through full counterflow design. Protects boiler and associated steam and condensate equipment from corrosive attack.

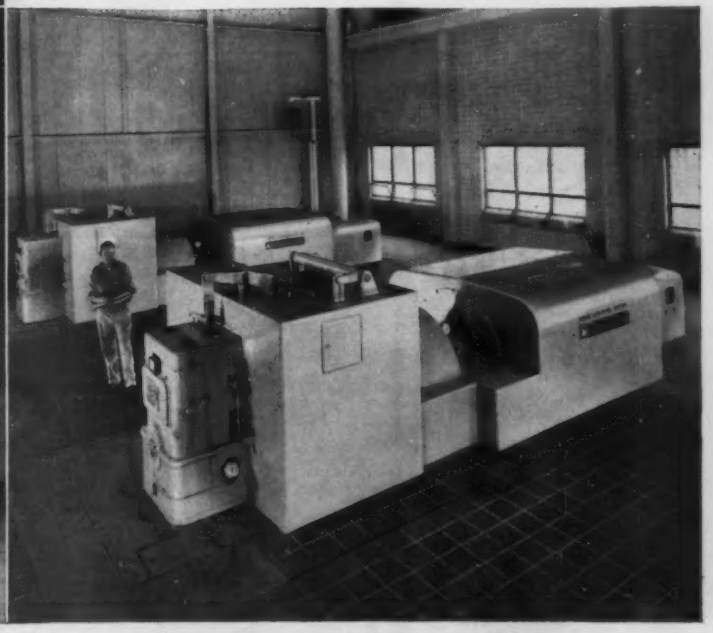


Lowest height, easiest access 5-kv metal-clad switchgear on the market. Just 72 inches high, you get eye-level instrumentation, shoulder-height accessibility of component parts. Other outstanding advantages: front-accessible current transformers; maximum compartmentation and dead-front construction for greater safety; full-panel metering; rapid, one-stroke breaker insertion. Choice of stored energy or solenoid operated circuit breakers.



Eliminate tuberculation and oxidation, reduce maintenance with rubber-seated butterfly valves. Operation is always extra-smooth and easy with 100% effective shutoff. Full body protection is offered by a rubber seat that extends through the valve body and over the flange faces. Angle seating protects the rubber seat and permits seating adjustment without costly disassembly. Being light and compact, these valves require less space and support than most other types.





Extra-compact rectangular steam condenser shape reduces space requirements. "Guided-flow" design achieves highest efficiency and vacuum with available water temperatures . . . gets maximum temperature condensate at the hotwell. Internal reverse-flow design for cooling water effectively backwashes debris, ends costly shutdown, conserves space, requires no additional piping. Planned-as-a-package auxiliary condenser equipment also available.

Two non-condensing, automatic extraction steam turbine-generator units (3000 kw) — for a hospital center where extraction and exhaust steam are used for heating and other services. You get the advantages of two steam pressures — high pressure by automatic extraction and low pressure from the exhaust. Use of pressure-reducing valves and desuperheaters is minimized where a wide range of process pressures is desired.

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An Engineer is not a Scientist...and vice versa

EDWARD HARRIS, Consulting Engineer

THE DIFFERENCE between the practice of engineering and the practice of science — between an engineer and a scientist — is far more than a matter of semantics. At a time when maximum efficiency and productivity is so essential, we would do well to recognize this difference. Educators confuse the issue; industry regularly uses people trained for one position in the other; the press adds to the misunderstanding with every report of technological advances; and students are not quite sure what they are studying, or why. The difference is all-important to our enterprise. Colleges must educate young men toward one profession or the other; industry must not mix their assignments. An engineer-scientist is virtually impossible, and a man trained in one field who is forced to work in the other seems to have little chance of success.

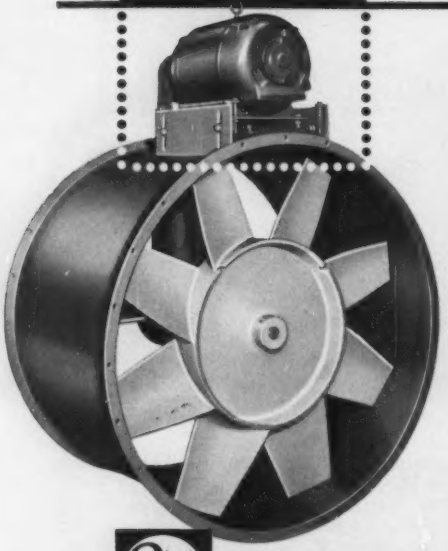
The trend toward the inclusion of humanistic studies in engineering curricula is most encouraging, but not if it comes at the expense of courses that will be more important after graduation. For example, some engineering schools are eliminating course work in such topics as ethics, comprehensive design, safety, plant management, economics, research, and oral communication. Educators justify these deletions with the claims that, in the years allotted for obtaining a first degree, there is no time available for this work. They insist that this time must be given to advanced mathematics, to advanced theory in this and that.

Who Needs What?

How many students want to go on for advanced study? How many want to practice engineering in fields such as construction, sales, consulting, production? We must assess the eliminations from standard course work in the light of the answers to these questions.

The practice of engineering is an art, and as an art, its success depends considerably on the exercise of judgment. Judgment cannot be taught; it must be practiced. The course work that modern educators would delete is precisely the part of engineering in which judgment is involved. We seem to be

CHANGE MOTORS...ANYTIME TO STEP UP CAPACITY!



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PROPELLAIR Type BT Fans, sizes through 60", have universal mounting plates which accommodate motors to 30 HP. All bearing assemblies are sized for 50 HP loads. BT Fans can easily be field-modified to boost or decrease capacity, regardless of original rating, simply by changing the motor and V-belt drive. Use BT Fans for low-cost general duty, for handling corrosive or explosive fumes, extreme heat or high humidity. Straight-line design permits easy, inexpensive installation. A wide range of propeller designs permits selection for maximum efficiency at the operating range involved. Fans bear AMCA Certified Ratings to 84,000 cfm, free air. Write today for Bulletin 625CE.

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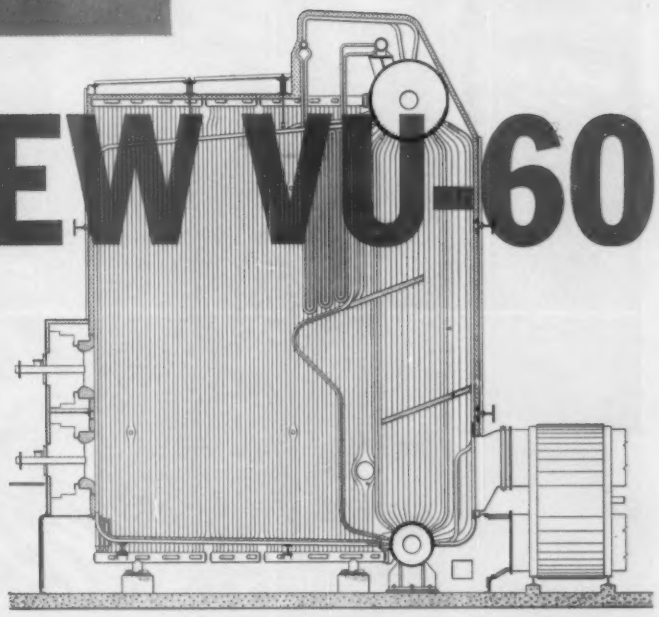
Now...a completely self-cased, MODULAR BOILER

C-E's NEW VU-60



DESIGN HIGHLIGHTS OF THE VU-60

Modular construction makes it possible to assemble custom designs from standardized components.

Boiler can be proportioned for best combustion, heat absorption and gas flow even when space conditions are limited or difficult.

Completely self-cased, the VU-60 is an all-welded gas-tight and pressure-tight envelope of finned furnace and boiler tubes. This results in less non-working weight per pound of steam capacity.

No external ductwork. The bottom of the boiler is a plenum chamber which allows air to flow direct from the air heater to the burner windbox.

Number of field-welded pressure parts is greatly reduced.

Cross flow baffling and symmetrical boiler bank mean low draft loss, no sluggish gas flow in any pass.

Requires only a simple, reinforced concrete slab. No conventional roller supports required.

Paneled construction cuts erection time.

No air heater supporting steel is required.

For pressurized or induced draft firing.

VU-60 SPECIFICATIONS

Capacities:	100,000 to 250,000 lb per hr
Design pressures:	250, 500, 750, 1000 psi
Steam temperatures:	To 900 F
Fuels:	Oil and/or gas
Firing:	Horizontal (front wall) or tangential
Size increments:	Depth — twelve Width — eight Height — three
Stream drum sizes:	Four

The VU-60 Boiler is a new and logical extension of C-E's service-proved VU series. Like all VU units, it is completely integrated, symmetrical in design, uncluttered and uncomplicated. Based on a standardized modular concept, it offers greater flexibility, yet stays within the bounds of solid and proven practice.

The VU-60 is a functional boiler. Completely self-cased, the exterior walls of this unit (furnace and boiler) are composed of finned tubes, shop welded into panels. The fins between panels are field welded to form a gas- and pressure-tight structure. Insulation is applied directly to the outside of these walls and is covered by pre-formed, field installed metal lagging. Thus non-working weight and bulk is reduced to a minimum.

The VU-60 is economical, it is dependable, it is accessible. It is easy to install and will meet your most exacting steam needs. Why not write for further information, or, if you prefer, contact the C-E office nearest you.

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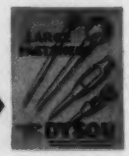


NEW BULLETIN ON LARGE FASTENERS

Every engineer needs this free digest of large fasteners.

Joseph Dyson & Sons, Inc., 5155 St. Clair Ave., Cleveland 3, Ohio, HE 1-6157

DYSON

putting aside the one part of the curriculum we need most of all.

Engineering colleges should stick to producing engineers, and the schools of science should stick to producing scientists. Both should note carefully that the best they can hope to do is to turn out young men well trained in fundamentals, young men who are ready to work toward full status in their respec tive professions.

A number of universities have begun to use the word "scientist" in defining the graduates of their engineering schools. If the engineering schools truly feel that they are producing scientists, they have made the error of believing that there is some real similarity between engineering and science. The product of their academic labors may be men half-trained in each of two distinct fields.

Ancient History

Very likely we could determine the whole of the difference between engineers and scientists by observing what each one does, but for completeness, our analysis will begin ahead of that point. Chronologically, scientists came first — if we will admit to science the early thinkers who observed and theorized about the world around them; and reject from engineering the men who built tombs, aqueducts, pikes, and other works almost solely on intuition. Generally speaking, the results of early science were not good by today's standards. The construction of the past has fared no better. Some samples of the early builders' work have held together, probably because of rather than in spite of the forces of nature. That is, the conservation of these structures has been the result of favorable but unpredicted interaction of natural forces. Many more examples have fallen than have remained standing.

Engineering has progressed, with growing pains, from the early military engineering to the present state, in which we have many

Compare Honeywell's latest air cleaner advances

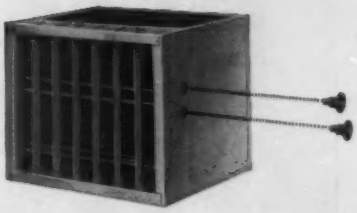
Exclusive Flutter-Jet* washing solves the problem of cleaning air cleaners

Honeywell's new Flutter-Jet washing system sweeps away collected dirt with a powerful stream of water. Its flexible rubber nozzle keeps water in larger droplets as it strikes the surface, assuring greater washing action. Attached to a moving manifold, it covers the entire area. It requires as little as 20 pounds of water pressure, and can't be clogged by salts or other impurities in the water. Flutter-Jet washing prevents breakdowns, reduces maintenance and increases efficiency.

Exclusive power safety system saves steps, assures maximum protection

A direct current sensitive relay in Honeywell's new power safety system makes it possible to control the power supply from a remote location. This permits the system to be reset without losing time going to the equipment itself. This new relay also enables you to hook the system up to a centrally-located alarm panel (see illustration), where an audible or visible alarm will be answered immediately. By providing a continuing check on equipment, it assures maximum protection and top operating efficiency at all times.

New intercell button connector cuts field installation time



Never before has it been so easy to make the electrical connections between cells. And this spring loaded ball and socket arrangement—less than 3 inches in diameter—is completely waterproof. Best of all, it features a plastic sealing ring of high dielectric strength that prevents loss from arcing as current flows between the cells. The new intercell button connector cuts installation time considerably and makes dismantling for service a snap.

New power pack features oversized selenium rectifiers for longer life

New oversized selenium rectifiers give this power pack greater dependability and a longer life. These solid-state rectifiers help stabilize the current output and maintain a constant peak inverse voltage. They are also mechanically shock resistant—a great advantage in shipping and handling. The power pack itself provides dual voltage for higher efficiency—90% at an air flow of 500 feet per minute.

Now you can specify the Honeywell Electronic Air Cleaner with even greater confidence. And only Honeywell gives you complete service back-up. Honeywell field engineers will supervise the installation, check out the equipment once it has been installed, and train the men who operate it. And an exclusive Honeywell maintenance contract assures your client maximum cleaning efficiency—through periodic inspections—for the life of the system. For details, call your nearby Honeywell office. Or write Honeywell, Dept. CO-7-111, Minneapolis 8, Minnesota.

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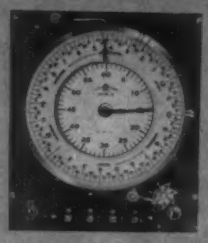
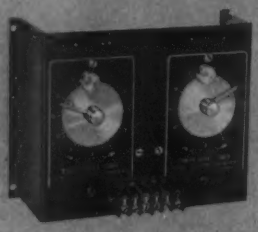


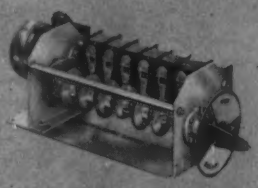
Program Clocks

Interval Timers

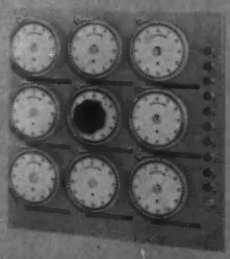
Time Delay Timers



Automatic Reset Timers



Multi-Circuit Cycle Timers



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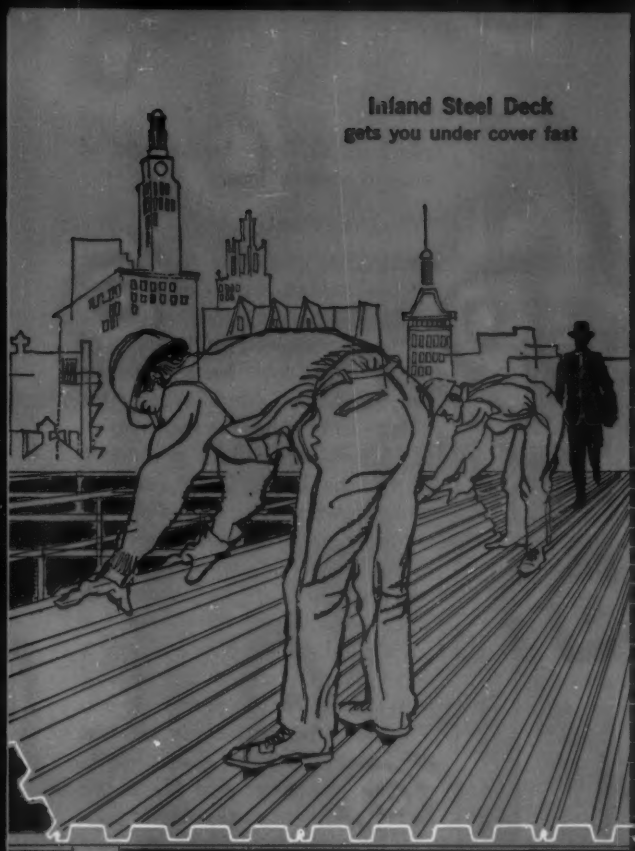
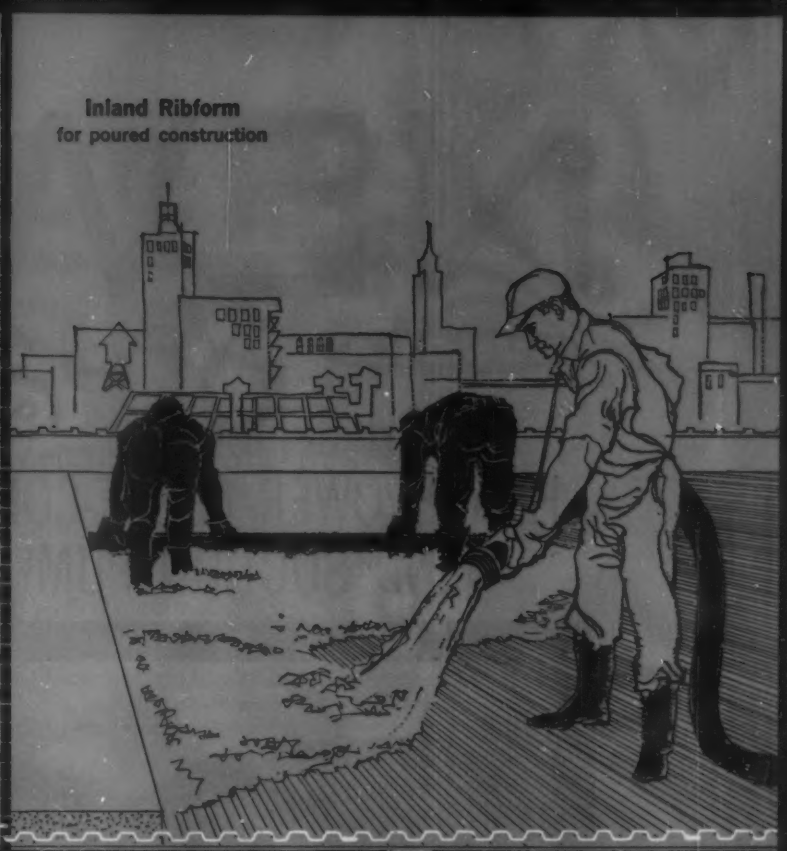
branches, many sorts of duties, many responsibilities, some considerable position in society, many members, fair incomes, and some children of our own in the drafting and technician areas. Meanwhile, what has science been doing? What once was a field of many semi-specializations gradually has become a group of narrower and narrower disciplines, yielding specialization of the highest order. True scientists now mostly feel that there is one science, and that whatever good answers they find must be a part of one grand answer.

Recent History

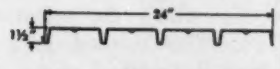
Before coming to what these two classes of technical people do, let us stop once more to investigate the situation a generation or so ago. There was a more marked delineation between the two fields of endeavor then than there is now. Scientists were working in the laboratories; most of them would be classed as applied scientists. Some were looking for basic truths, but more were striving to answer particular questions about particular substances in particular conditions. A very few were delving into abstract matters. How many of these were true scientists? A reasonable answer seems to be that only the last small group included true scientists. At the same time, engineers were busy developing, designing, and building some of the magnificent structures we use today. Some methods were technically sound, the best that could be said of some others is that they worked. At any rate, the jobs were done, which is the reason engineers were used.

Today the world is changing at an accelerated rate. Only one of the characteristics of environment in which the scientists and engineers are working was conceived of a few years ago. That one is time. Distances, velocities, population, wages, morals, and so on, have undergone great change in a short time. Today's technical peo-



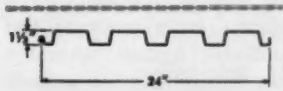


Steel deck or centering...you name it, INLAND has it!



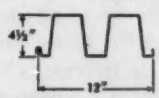
A-DECK — For purlin spacings not exceeding 8'4". Narrow ribs provide deck surface that supports the thinnest or softest types of insulation.

H-DECK — New! For simple spans to 20'0" — 3" and 4½" depths. Especially practical to cover walkways in shopping centers, schools, other installations.

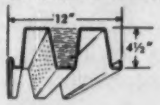


B-DECK — For spans to 10'0". Wide rib distributes metal for greater structural efficiency. Well suited for use as side wall panels.

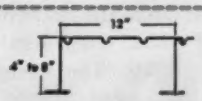
B-ACOUSTIDECK — Two-in-one panel combines steel roof deck with acoustical ceiling having Noise-Reduction Coefficient of .70. Used for spans to 10'0".



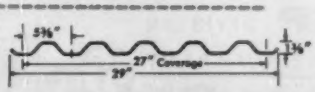
C-DECK — Carries normal roof loads over spans up to 24'0". Used extensively in canopies.



C-ACOUSTIDECK — Offers same Noise-Reduction Coefficient as B-Acoustideck. Can be used for spans to 24'0".



T-STEEL — New! Galvanized only. For clear spans to 32'0". Adaptable to acoustical and flush, luminous ceiling treatments. Provides superior diaphragm to resist seismic and wind loads.



RIBFORM — High-tensile, galvanized steel form for concrete slabs over spans up to 8'0". Three types: Standard, Heavy-Duty, Super-Duty (shown).

Expansion projects and new buildings get under cover fast and economically, when you specify an Inland roof system.

Inland steel deck is easy to handle and weld in place — in any weather that a man can work. Effects of construction abuse are held to a minimum, since types A, B, C, and H decks are Bonderized, then covered with a baked-enamel primer that resists on-the-job damage. One field coat of paint over this is usually enough.

In concrete-over-steel construction, Inland Ribform supports wet concrete with minimum deflection. Rigid sheets are quickly and inexpensively attached to supports — in place, they provide a safe work platform for crews.

Write for catalog 248 – see Sweet's sections 2i/InL. For help on unusual problems, you can draw on the diversified experience of Inland sales engineers. Write or call your nearest Inland office.

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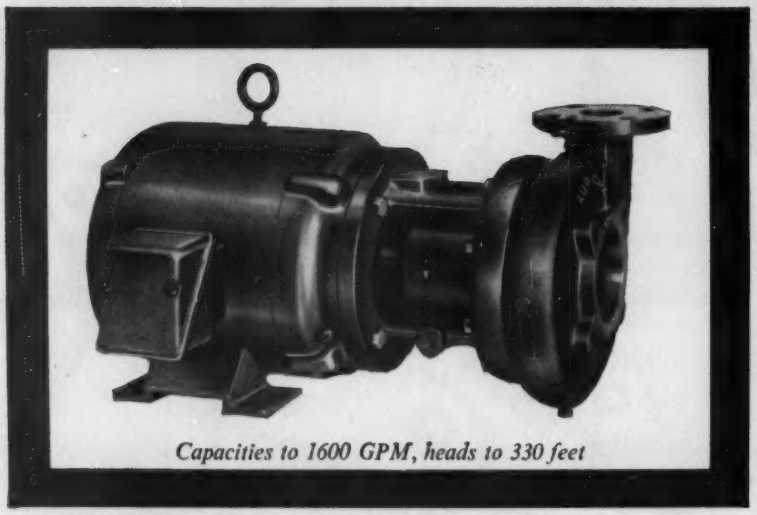

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ple face problems in the light of entirely new values.

Who Does What?

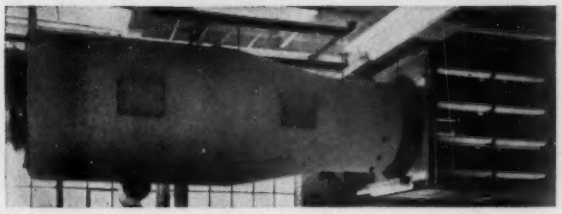
Definitions are made to be bent or broken but are sound starting points. Engineers, then, are people technically trained in the use of mathematics and basic scientific principles, and their reason for being seems to be that their knowledge and skills will be productive of a better life at lesser cost. Argument with this definition will certainly arise, but add to it or alter it at will and your alterations will make no appreciable difference when we compare it to what a scientist does. Engineers form a substantial element of the corps of men needed for the life we know. Life would be more costly and less comfortable without them. It is difficult to comprehend life as we know it without engineers, or people doing what engineers do.

What a scientist does is quite another matter. A true scientist spends his energies working in the scientific method; as a matter of fact, he becomes a part of it. He cannot be said to be practicing science if he does otherwise because the scientific method is the only method which yields the results for which the scientist is striving. This method is a far cry from the method of the engineer. In detail, the scientist makes controlled (well directed) observations, forms proper hypotheses, performs experiments to test the hypotheses against several references, forms theories, extends the theories to predictions to make the theories useful, and finally, establishes controls over the use of his work. Whether he recognizes it or not, this is what he does. If he is negligent in doing these things (formally or informally) he yields his position as a scientist.

An engineer, if he is worth his salt, is occupied simply with getting a job done. His restrictions are codes of ethics, costs, legal codes, and availability. The scientist has

SUCCESS STORY

of a revolutionary air conditioning system!



CARRIER ROTASPRAY units require less than ⅓ the space of a conventional system of the same capacity—may be ceiling hung, wall cantilevered or mounted on the roof.

Six years ago Carrier pioneered an entirely new concept in air conditioning for industrial applications—the Rotaspray Weathermaker* System. It is now in operation in such widely different fields as textiles, plastics, rubber, candy, steel, cigar, paper, leather and garment. What is its record of performance? The best indication is the many repeat orders we've had . . . and are getting . . . from satisfied users. Can you use the Rotaspray System to advantage? Here are some of many reasons why it may be the best answer to new construction or reconversion problems.

UNITARY DESIGN. Instead of complete central station systems which require larger apparatus rooms, Rotaspray units are spotted conveniently throughout a plant. Only one central water handling apparatus is required.

FLEXIBLE INSTALLATION. Because of the compactness and low operating weight of Rotaspray units, they can be installed either ceiling hung, wall cantilevered or roof top mounted.

LOW MAINTENANCE. Rotaspray units incorporate self-cleaning "Cant-Clog" nozzles and a self-cleaning eliminator. Compared with large central station systems, they reduce cleaning and maintenance costs as much as 80%.

LONG LIFE. Rotaspray units are fabricated of stainless steel and other durable materials to assure years of virtually trouble-free operation.

HIGH EFFICIENCY AIR CLEANING. Each Rotaspray unit separates dust and other particles from the air . . . assures a "scrubbed clean" air supply at all times.

BETTER TEMPERATURE AND HUMIDITY CONTROL. By a new control method especially designed for the system, the old method of dew point control has been eliminated. Zoning control has also been eliminated. Each Rotaspray unit accurately controls temperature and humidity in its own area.

For complete information, write Carrier Air Conditioning Company, Syracuse 1, New York. In Canada: Carrier Air Conditioning Ltd., Toronto 14.

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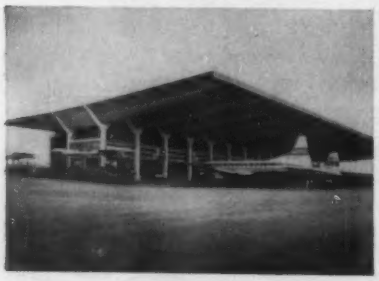
	(2) Cantilever Hangar
Delta Airlines	(3) Loading Pier
	(4) Maintenance Hangar
	(5) Fuel Tanks
American Airmotive Corp...	(6) Cantilever Hangar
Miami Skyways Motel	(7) Deluxe Motel



Cantilever hangar pictured at left was project No. 2 for National Airlines. Architect: Weed, Russell, Johnson and Associates, Miami; Consulting Engineer: Ammann & Whitney, New York; Soil Consultant: D. M. Burmister, New York; Contractor: Fred Howland, Inc., Miami.

Write for Booklet B-27

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no restrictions, by man or by authority, since the truth for which he searches does not have these restrictions.

A comparison of the work of the two classes of men gives very few points of similarity. Engineers use in particular cases what scientists have shown to be generalities. Engineers look to codes and authority for guidance; true scientists look to nothing but truth. Engineers think constantly in terms of dollars; scientists do not care whether the newly discovered element costs a few cents or a million dollars per milligram. Engineers try by works to improve man's lot; scientists do so only if this is compatible with truth. Surely the world needs both classes in large numbers, but the need does not make a combined class of them.

The Future

Industry must use engineers to get the jobs done, scientists to do research and the basic studies. Misplacement of these men will insure production of unrealistic reports, insufficient results, faulty conclusions, unsound general theories, and a host of other unacceptable and costly ends.

Educational people are responsible for the formal training of both groups. Either is a formidable problem; to do both at once is a more difficult problem. To do both at once for the same student may be impossible. This latter attempt will produce scientist-engineers, or engineer-scientists, a sort of half breed, not well prepared to occupy his place. Educators must make up their minds about this, holding firmly to their decisions.

The nation needs more engineers just as it needs more scientists, and these engineers should be the product of engineering schools. This is a serious enough problem that those of us in engineering schools who revel in problem solving need not borrow from the scientific areas any part of their problem. ▲▲

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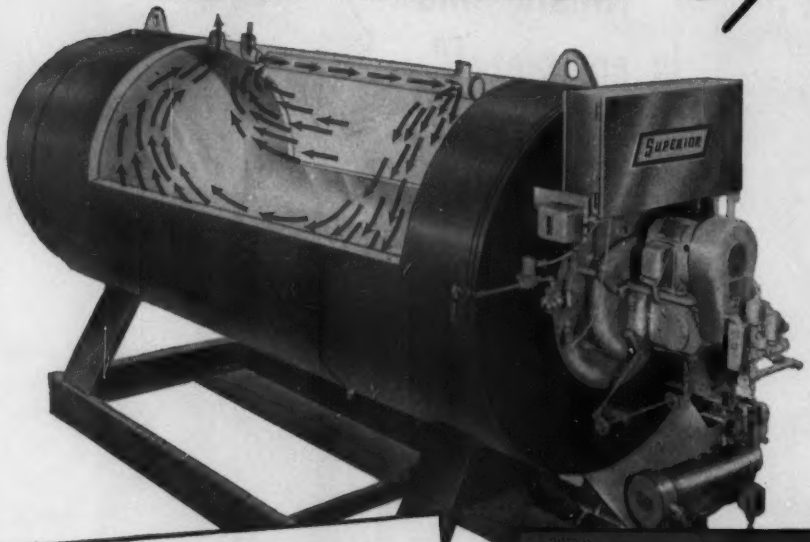

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This new Superior Hot Water Boiler eliminates the problems resulting from the use of steam boilers for hot-water heating. Most of these stem from improper circulation within the boiler.

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In addition to its special hot-water design, features include 4-pass down-draft design, 5 sq. ft. of heating surface per bhp., built-in induced draft, fully automatic operation firing gas, oil or both, and a host of other features described in detail in the new catalog illustrated at left.

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For sizes to 20,100,000 Btu's/hr., write for catalog CFW-13.

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SUPERIOR PACKAGED BOILERS

The Word From Washington

EDGAR A. POE, Consulting Engineer Correspondent

Situs Picketing

Labor's "common situs" picketing bill apparently is dead. The Consulting Engineers Council and the National Society of Professional Engineers made strenuous objections to it; however, the bill seems to have died of natural causes.

Disclosure of labor abuses at Cape Canaveral did not create an atmosphere for passing expanded construction strike privileges. Also, the unions could not agree on what they wanted the common situs bill to include.

The final blow may have come when the bill went to a committee which included ardent integrationists, who long have tried to push integration in construction unions. At last report, the unions had taken no steps toward integration, and the committee had taken no steps toward passing a common situs bill.

Engineers Scooped

A nonprofit educational and research organization, the Institute of Public Administration, has been given a $98,000 project to study our present urban transportation and suggest ways in which it can be improved.

Meanwhile, Senator Humphrey's 1961 Water Pollution Bill is making its way through legislative channels. Included in this bill is a clause that would allow retention of "Chemists, physicists, engineers, and such other personnel as may be deemed necessary and any educational institutions, scientific organizations, or industrial or engineering firms suitable to do any part of the research and other essential work."

Economic Redevelopment

The Area Redevelopment Administration of the U. S. Department of Commerce has started operations with an initial authorization of $200 million. Under the direction of William L. Batt, ARA will assist economically depressed areas with loans for community, industrial, and commercial projects; grants for public facilities; technical guidance; and occupational retraining for the unemployed.

Programs are approved for specific areas on an eligibility basis, determined by the unemployment level and locally-developed plans for improvement. Further information is available by writing the ARA, Department of Commerce, Washington 25, D. C.

GSA Procedure

The General Services Administration, which conducts the Federal government's nation-wide public building program, has made an important change in Federal procurement regulations. Contractors now are required to supply a bid guarantee representing 20 percent of the bid amount (but not more than $3 million) for construction or repair of Federal buildings. The bid guarantee was raised late last year from 2 to 20 percent. The GSA says that many contractors, unaware of the change, have made inadequate guarantees under the new regulation, forcing rejection of their bids.

Also, GSA has recently issued a booklet, *Doing Business With the Federal Government*, which explains government procedures in dealing with small businesses for materials or services. The manual is intended to help those firms who would like to do business with the government, but who have not known how to go about it. The book sets forth the steps a businessman must take to sell the government, the responsibilities of government contractors, and samples of bidding forms.

Ethiopian Study

The U.S. Coast and Geodetic Survey has just completed a four year geodetic survey of the Blue Nile River basin in Ethiopia, establishing 365 positions and 965 elevations in an area of about 120,000 square miles. The survey, the most modern of its kind to be made in Africa, was part of a Point Four agreement between the U. S. and Ethiopia signed in 1956. Through a special service arrangement with the International Cooperation Administration, 12 USCGS technicians

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directed the survey and trained Ethiopian nationals in surveying techniques.

The final survey covered about one-fourth of the country, and set bases for the Ethiopian government to use in completing a full-scale survey of the entire country within the next few years.

Work in Latin America

Obviously concerned over the possible spread of Communism throughout Latin America, the U. S. government and several Western bloc banking organizations have approved loans and grants for the technical development of Central and South America. Proposed economic and technical development in the affected areas will require a great deal of outside assistance, much of it from consulting engineers.

¶ Congress has approved a half-billion dollar appropriation for assistance to Latin American projects. The money, to be used specifically for projects that will improve the personal living conditions in these countries, went to the International Development Bank, $394 million; the International Cooperation Administration, $100 million; and the Organization of American States, $6 million.

¶ The International Development Associations, a new affiliate of the World Bank, marked the beginning of its financing operations with a $9 million development credit to Honduras for highway construction and maintenance. The IDA, with 42 members and an initial subscription of $863 million, will assist those countries which are unable to achieve satisfactory economic development through conventional financing. The IDA credit is interest-free, and runs for a term of 50 years.

¶ The Development Loan Fund of the U. S. government has approved a $1.8 million loan to Ecuador, for use in aerial survey of unexplored regions of the country. The chief object of the survey will

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be to determine which sections of Ecuador have a potential for future economic development.

¶ The World Bank has arranged for extended engineering surveys of two South American countries, with particular emphasis on transportation improvements.

A survey of Peru's highway facilities and the existing regulations governing inland transport is being made to establish a highway investment program and an effective organization for regulating inland transport. The New York engineering firm of Coverdale & Colpitts will conduct the survey.

The government will finance the local cost of the study and will share the foreign exchange cost with the Bank. The consultants will prepare a report recommending a highway program for a 10-year period, indicating the priorities for investments in main roads, feeder roads, and penetration roads. The report also will include recommendations for organizational improvements in the Highway Department of the Ministry of Development and Public Works and other government bureaus.

The engineering firm of Parsons, Brinckerhoff, Quade & Douglas is dispatching 13 experts to Colombia to conduct a survey of Colombia's transportation facilities and needs with the objective of formulating a coordinated transportation investment program.

The Colombian National Railways has also engaged four consultants from the New York engineering firm of Coverdale and Colpitts to advise the railway on its management as well as its investment program. The consultants will submit a report recommending a coordinated program for investment in highways, railways, ports, and airport.

SHOULD YOU RECOMMEND EMERGENCY LIGHTING TO YOUR CLIENTS?

Statistics show that power fails for 60 minutes in any four and one-half year period with multiple underground transmission up to 50 minutes in every eleven month period in some rural areas.

Based on these figures, no building should be without emergency lighting.

To make your recommendation job easier, Light Warden offers you the Emergency Lighting Handbook. Edited by a Professional Engineer, the Handbook includes typical installations, design problems, efficiencies and information on available lighting units.

A copy of the Emergency Lighting Handbook will be return-mailed at your request. Please write on your letterhead.

LIGHT WARDEN Chargomatic emergency lighting equipment

ELECTRIC CORD COMPANY

41 Plane Street, Newark 2, New Jersey

Loans to Consultants

The Small Business Administration, known primarily for its financial assistance to small industrial and commercial firms, announced recently it had approved a direct loan of a quarter million dollars to a Washington, D. C. consulting engineer. The SBA noted that consultants are "as eligible for loans as anyone else." The interest rate on a direct loan from the Small Business Administration usually runs about 5½ percent.

Interstate Progress

The latest report from the Bureau of Public Roads shows that more than one-fourth of the 41,000-mile interstate highway network is now open to traffic. Approximately 10,700 miles of the divided highway is complete, and work is progressing on another 4500 miles. In addition, preliminary work — right-of-way acquisition or engineering — is under way on another 10,500 miles. Thus, work is under way or completed on about 26,000 miles of the interstate system, about 65 percent of the total. ▲▲

Above is a specially-designed container-handling crane, just one of many types of lifting equipment built by AMERICAN HOIST.

can you use this experience in serving your clients?

Whenever you're called in on an assignment that involves heavy lifting equipment — chances are good that AMERICAN can offer *direct experience* on a project similar to yours. That's because we design and build practically *all* basic types of hoist and crane equipment . . . for lifting *any* load up to 800 tons. You can come to us for unbiased recommendations involving bulk unloaders • gantry cranes • revolver cranes • bridge cranes • locomotive cranes • crawler and rubber-tired cranes • hoists and derricks • and specially engineered products. No other company comes close to offering this range of lifting equipment . . . and few can approach our nearly 80 years' experience.

We are proud to have cooperated with consulting engineers on hundreds of materials-handling installations in the past. We hope we will have an opportunity to work with *you* in the near future.

EP-1002

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AMERICAN HOIST
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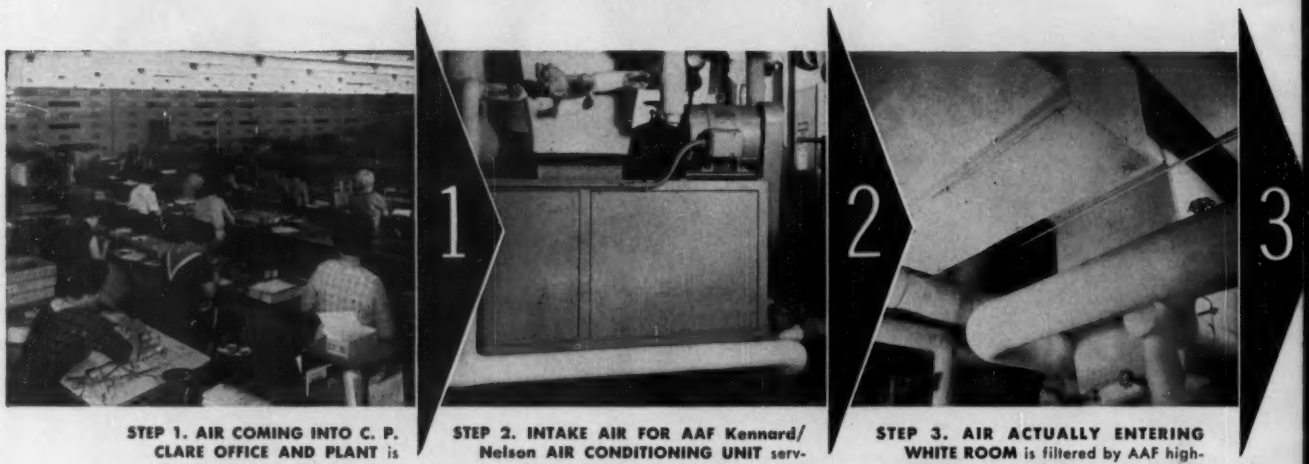
ST. PAUL 7, MINNESOTA

AAF keeps white-room

3-step air cleaning system utilizes three different types of AAF filters



STEP 1. AIR COMING INTO C. P. CLARE OFFICE AND PLANT is cleaned by completely automatic AAF Electro-Matic electronic precipitators.

STEP 2. INTAKE AIR FOR AAF Kennard/Nelson AIR CONDITIONING UNIT serving white room is further cleaned by AAF Electro-PL filters which combine the principles of electronic and dry-type filtration.

STEP 3. AIR ACTUALLY ENTERING WHITE ROOM is filtered by AAF high-efficiency Type F filters enclosed in the duct running from the outlet of the air conditioning unit to the white room.

White room operations involving the assembly of electrical relays demand ultra-clean air and rigidly controlled temperature and humidity. The planners of the new addition at C. P. Clare Co., Chicago, determined that their white room should have a complete air system all its own. Logically, they turned to AAF.

AAF provided one type of electronic filter for cleaning the air ventilating the office and plant. Another type of electronic filter cleaned this same air again before it entered the high-pressure air conditioning unit (AAF Kennard/Nelson) that controlled temperature and humidity for the white room. Still a third type of AAF filter—this one the most efficient of the three—was installed in the duct leading from the air conditioning unit to the white room itself. Result: white-room air to white-room standards—99.97% dust-free, constant 72° temperature, and controlled humidity.

This white room system points up AAF's capacity for clean-air engineering. Only AAF makes *all kinds* of filters. Thus, AAF can always fit the right filter (or combination of filters) to the needs of the specific air-cleaning job. For information on all the AAF products in operation at the Clare plant, call your local AAF representative or write us direct. Address: Robert Moore, American Air Filter Company, Inc., 300 Central Avenue, Louisville, Kentucky. In Canada: American Air Filter of Canada, Ltd., 400 Stinson Blvd., Montreal 9, P. Q.

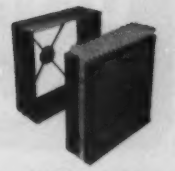
AAF **American Air Filter**

BETTER AIR IS OUR BUSINESS

air *white-room clean!*

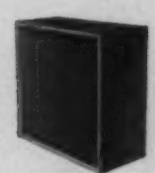
Architects: Rapp & Rapp, Chicago; Consulting Engineers: J. P. Bazzoni & Co., Chicago

AAF Electro-Matic
Electronic Precipitator
Bulletin 250



AAF Electro-PL
Electronic Dry-Type Filter
Bulletin 257

Kennard/Nelson
Air Conditioning Unit
Bulletin AC 100



AAF Type F
High-Efficiency Filter
Bulletin 238

Long grate bars with closely fitting overlay joints prevent leakages. Venturi air openings are spaced to provide uniform air distribution.

GRATES ARE THE GUTS OF A STOKER ——— DETROIT ROTOGRATE HAS PLENTY OF INTESTINAL FORTITUDE

No matter what else it has, no stoker can be a complete success without trouble free efficient grates.

The Detroit RotoGrate Stoker has other outstanding features in abundance but without the superior grate design it could never have achieved such instant and lasting success.

The advent of the RotoGrate Stoker established a whole new trend in coal firing and stimulated many competitors but none has seriously challenged the superior performance and long life of the RotoGrate.

Our grates are high resistance metering type with venturi air openings spaced to provide uniform air distribution. Long grate bars have close fitting overlay joints to prevent leakages that cause blow holes and burnouts.

Sturdy construction and use of special alloy iron makes these grates long lasting under the most exacting service.

Guide chains riding over toothed sprockets assure positive grate bar alignment. A unique method of attachment avoids chain wear and stretching, while the catenary take up of slack prevents jamming.

Forward travel continuously discharges ash. Automatic combustion control varies the speed of travel in step with fuel feed rate to maintain uniform fuel bed while following fluctuations in load.

Burns all grades of bituminous and lignite coals, also many kinds of refuse and by-product wastes.

The RotoGrate for boilers to 400,000 pounds steam per hour capacity; other Detroit Stokers for capacities from 3,000 pounds steam per hour.

DETROIT STOKERS COST LESS

Cost equals initial investment plus upkeep plus production losses due to equipment outage. The total is less with Detroit.

Even distribution of air is assured by metering type air openings.

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DETROIT SINCE 1898 STOKERS

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REPORT FROM FRANCE

Harnessing the Tides

French engineers hope that their River Rance project, now under construction, will prove an efficient and economical way to provide power from the sea.

FOR AS LONG as man has been aware of the rise and fall of the tides, he has dreamed of one day harnessing their power. Water mills have been devised to make some use of tidal currents — but the tides have an intermittent action. They will not ebb and flow at man's convenience. The times when a tidal station can develop power seldom coincide with the times when that power is most needed.

Early Plans

Several years ago, French engineers began trying to harness the River Rance, which flows into the English Channel between St. Malo and Dinard, on the coast of Brittany. Some of the early experiments were successful, but financial and political crises forced deferment of the plans to complete the project. Now the government has decided to go ahead with the scheme, and has authorized construction of a dam for what will be the first tidal power station.

The project is being carried out for Electricite de France, the nationalized French electric company, according to plans prepared by professor Robert Gibrat, of the Ecole Nationale Suerieure des Mines, in Paris. The plans call for a yearly production of 625 million kwh of current by 1966.

The Rance project is considered only a preliminary to a much larger operation that will harness the tides of the entire Bay of St. Michel, in the northwest corner of France opposite the Channel Islands.

Total Output

An important fact about the Rance scheme is that it is designed to draw more power from the tides than is dissipated through natural friction. The motion of the tides is much like that of a pendulum; once started, very little effort is required to keep it moving back and forth. The only energy that must be supplied is that needed to make up what is lost by friction. In the instance of the tides, this is the energy lost in eddies and back-currents, particularly in narrow and shallow regions. It has been estimated that the total power going to waste in the tides of the world is limited, amounting to less than presently is used by man to operate all his machines.

The natural losses in the Rance estuary are estimated at 60 megawatts. The French engineers hope to build a tidal station with a capacity of four times that amount.

The basic design is simple. The mouth of the estuary will be dammed, and the tide allowed to flow in and out through turbines. There will be 24 units, each producing 10 megawatts. The projected maximum station potential of 240 megawatts compares fav-

EST. 1856 McDonald

McDONALD BRASS GOODS ARE EXPERTLY MACHINED . . . AND ALL WATER SERVICE FITTINGS ARE INDIVIDUALLY TESTED - ASSURING THE FINEST QUALITY.

CORPORATION STOPS. With straight coupling nut. INLET: AWWA thread. OUTLET: Standard AWWA thread for copper service pipe. Sizes ½" thru 2".

NEXT TIME YOU BUY BRASS GOODS

Specify McDONALD

You can rely on good workmanship and good quality brass when you specify McDonald.

Here's the reason why: McDonald's have a 105-year old reputation for reliability. McDonald Brass Goods are made only of the best available materials.

McDonald's pride themselves on their high standards for constant quality control. Only the best in brass goods ever leaves the McDonald plant to fill your order. — CONTACT McDONALD FOR YOUR BRASS GOODS REQUIREMENTS.

CURB STOPS. Designed for dependability with threads according AWWA specifications.

ANGLE METER STOPS. Plain or lock wing style. Sizes 3/4" & 1".

EXTENSION SERVICE BOXES. Complete with stationary rod for curb stops ½" to 1" inclusive. (Send for Catalog sheet listing other models.)

Write for complete details and specifications.

A. Y. McDONALD MFG. CO.

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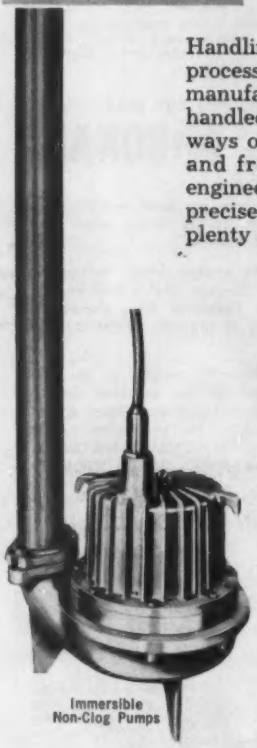
BRASS GOODS ● PUMPS
OIL EQUIPMENT ● DRAINS

here's why **most plant engineers prefer WEINMAN PUMPS**



Immersible Non-Clog Pumps

Handling of liquids . . . for heating, cooling and processing . . . is an important facet of modern manufacturing. The tremendous volume of fluids handled prompts today's industrial engineer to find ways of insuring a steady flow of vital liquids to and from the job. That's why more and more engineers are turning to Weinman to meet their precise pumping requirements. And, they find plenty of reasons to back their buying decision:

1 **WEINMAN EXPERIENCE.** More than 50 years of pioneering developments that are today's standards assures you of the right pump for each job.

2 **COMPLETE PUMP LINE.** Every type of centrifugal pump to meet any pumping need. You're sure that the pump you buy is the best pump for the job.

3 **QUALIFIED RECOMMENDATIONS.** Made after a careful analysis of your present and future pumping needs. You get the pump that fits your job today *and* tomorrow.

4 **SIMPLE DESIGN AND RUGGED CONSTRUCTION.** Weinman Pumps are built for easy maintenance and long, trouble-free service.

5 **INSTALLATION AND SERVICE.** You get skilled assistance before, during and after installation to insure proper operation twenty-four hours a day.

When you're faced with a pumping problem . . . get the right answer from your Weinman specialist . . . you'll find his name in the Yellow Pages. Or, write to us.

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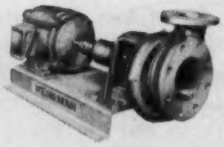
General Service Unipumps

Split Case, Multi-Stage Pumps



Single Stage, End Suction Pumps

THE WEINMAN PUMP MFG. CO.
290 SPRUCE STREET COLUMBUS 15, OHIO
CENTRIFUGAL SPECIALISTS

orably with the largest conventional hydroelectric power stations.

Turbine Requirements

The predominant advantage of the Rance project will be its ability to provide power when it is needed — at peak consumption periods. Being able to predict the tides accurately, the operators of the project will be able to correlate this with the pattern of expected peak demand to provide power efficiently. Water will be stored on one side of the dam during slack periods.

The turbines used in the tidal station have to meet a rigid series of specifications:

¶ Turbine action must be efficient regardless of the difference in water level on opposite sides of the dam. (The station will operate at a head varying from 3 to 40 feet.)

¶ Turbine action must be reversible, i.e., the station must be operable with flow in either direction.

¶ Turbogenerator units must be reversible so they can be used to pump water behind the storage dam in slack periods.

¶ Water flow through the unit must be free when the turbine is stopped.

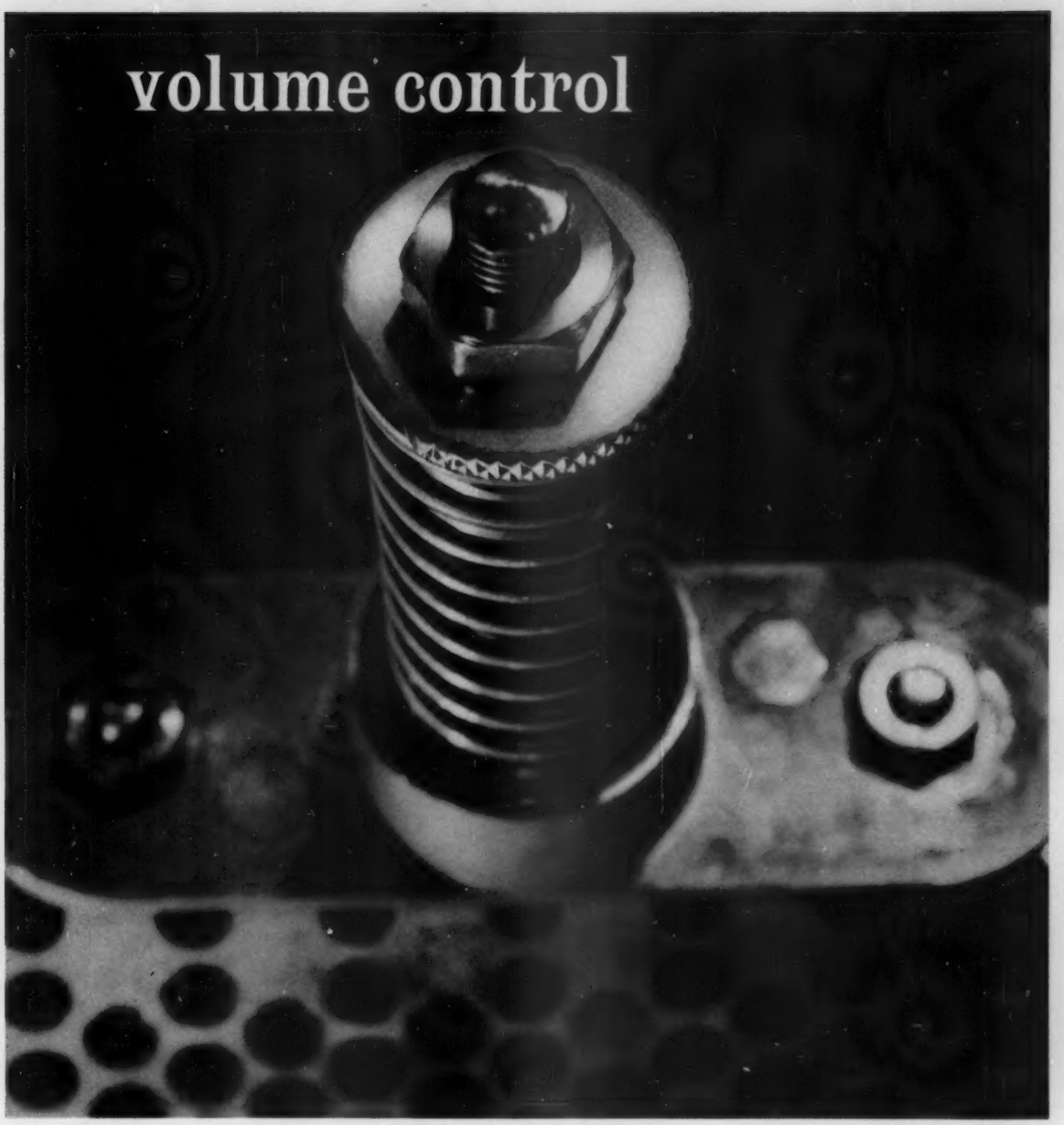
Actual Construction

The dam for the project will stretch a half-mile from one side of the estuary to the other, incorporating a rocky island in midstream. The power units will be built into the western section of the dam; the eastern section will include sluice gates and a lock for navigation. There will also be a provision for installation of additional power units in the future.

Originally the project was estimated to cost $67 million. That was in 1957. Three years later, the estimates had risen to $78 million, and the present budget for the project includes provision for additional increases in cost.

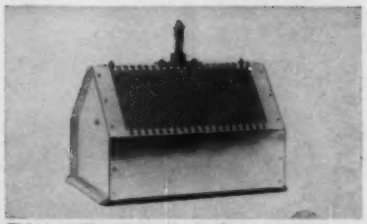
The first turbines will not be installed until 1964, and, if work goes as scheduled, the station will begin feeding power into the French national grid sometime in 1966. ▲▲

volume control



All it takes is a turn of this knurled nut to adjust a Buensod Dual Duct air mixing unit for the exact air volume desired. (The smaller nut locks the adjustment.) And constant volume is maintained ±5% regardless of static pressure variance. There's never a problem of system balancing, no sudden blasts or cut-down due to operation of other zones in the system.

Dual Duct high velocity air conditioning fits new structures or renovations with equal ease. Consider this advanced, year-'round system for inclusion in your next project.



This tent-like apparatus is the heart of Buensod's Automatic Volume Control.

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BUENSOD-STACEY

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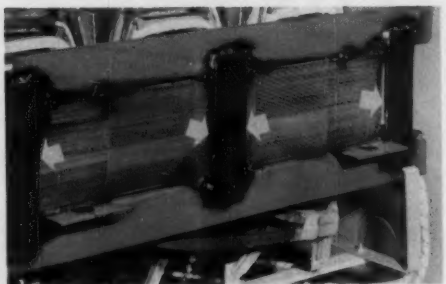
QHT* dry-type transformers

Research and testing in anechoic chamber of General Electric sound laboratory help maintain low sound levels of QHT transformers.

Built-in vibration-dampening rubber cushions isolate the rugged case of General Electric QHT transformers from core vibration, main source of transformer noise.



Welded steel clamps on higher ratings of General Electric QHT dry-type transformers keep the core laminations firmly in place to minimize vibration and reduce sound.

How General Electric Designs "Quiet" Into QHT Dry-Type Transformers

Choosing the quietest transformer for schools, hospitals, office buildings, and other places where noise could be a problem is now easier than ever. General Electric's new line of QHT dry-type transformers is at least 15 decibels quieter than older designs, and the *actual rating appears on each transformer.* As the chart below shows, each rating of QHT transformers has a sound level equal to or less than the NEMA standard.

Full-time research and testing in General Electric's sound laboratory provide General Electric engineers with information needed to design and maintain the low sound levels of QHT transformers.

Vibration is minimized on larger size units by welded steel clamps which hold the transformer core in a rigid position. In addition, on QHT units rated 30 kva and up, vibration-dampening rubber cushions isolate the case from the core and coil assembly. Consequently, core vibration passing through mounting brackets and conduit to surrounding surfaces is practically eliminated.

QHT transformers also save production space because they offer savings up to 50 percent in weight and 67 percent in size compared with competitive dry-types. You can mount QHT units in out-of-the-way places near the load and save the cost of long, low-voltage feeders.

Installation is fast and easy. You wire QHT transformers from the front. Convenient dual-sized knockouts, large terminal compartments, solderless connectors, and numbered terminals save time.

You can get 24 hour delivery on most models from your nearby General Electric distributor. Call him for more information, or write for GEA-6907A "QHT Specifier's and Buyer's Guide" to Section 411-15, General Electric Co., Schenectady 5, N. Y.

**Registered trademark of General Electric Co., for quiet, high temperature, dry-type transformers.*

KVA	QHT DECIBELS†	NEMA STANDARD
BELOW 5	40	45
5–9	45	45
10–30	45	50
37½–112½	45	55
150	45	60
167	55	60
225–300	55	62
500	60	—

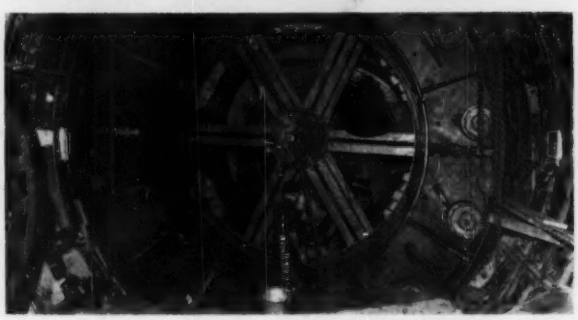
† Measured per NEMA Standard St. 1.411. The average office has sound levels from 55 to 65 decibels.

Progress Is Our Most Important Product

GENERAL ELECTRIC

STAFF REPORT

Test Tunnels For London's New Subway



Completed concrete section (above), and digging shield at work in iron section.

IN A TEST of new tunnel lining methods, two experimental tubes, totalling about one mile in length, are being built in London, England, for the London Transport Executive. Results will determine the method to be used on a new line of the London subway.

The test tunnels eventually will be joined to form a section of the new line. Progress so far indicates that either of the two methods can save several million dollars in construction costs.

Concrete vs Cast Iron

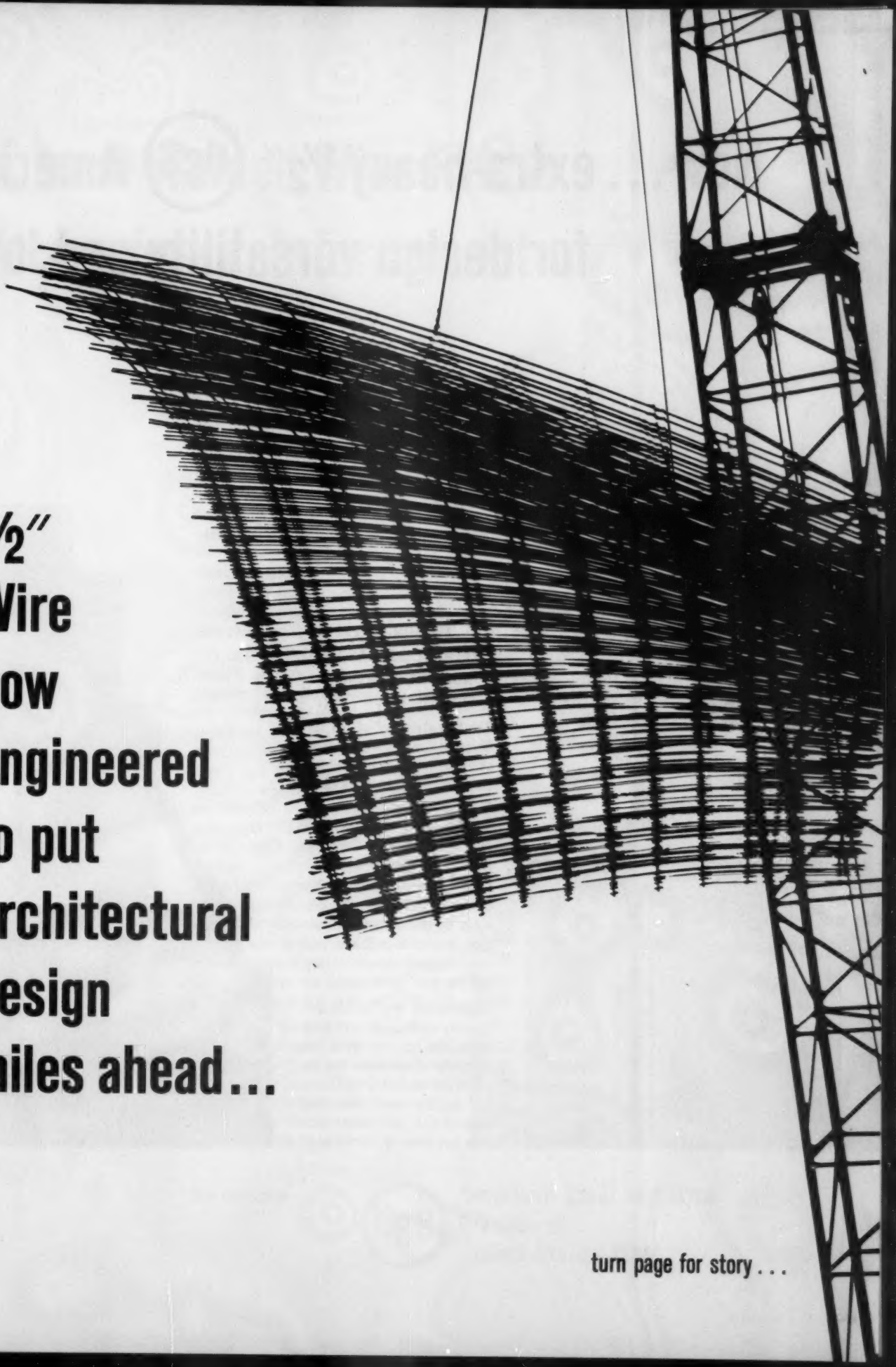
The essential difference in the two operations is in the lining of the finished tunnel. The first section is lined with pressure fitted precast concrete blocks. The second section is lined with cast iron plate, thinner and more easily handled than any other in common use.

The concrete lined section, from Finsbury Park to Manor House, was designed by the consulting firm of Sir William Halcrow & Partners, with construction by Kinnear Moodie & Co., Ltd. The cast iron lined section, from Netherton Road to Manor House, was designed by the consulting firm of Mott, Hay & Anderson, with construction by Edmund Nuttall Sons & Co., Ltd. The actual tunnelling apparatus for both sections was designed & fabricated by KM.

Record Speed

Each tunnel will be a double shaft. A single shaft of each section already has been completed. So far, the cast iron lining seems to be easiest to erect. The contractor on the Netherton Road section has completed 934 feet, including excavation and finishing, in two weeks. A record speed of over 3½ feet per hour was reached in one 24-hour period, when 88 feet of tunnel was built. This is double what is ordinarily considered fast work for such construction.

The actual boring apparatus is unusual only in its high degree of efficiency. The digging shield is a double drum, 14-ft in diameter on the concrete section and 13-ft in diameter on the cast iron section. The cutting face of the digger is turned at a speed up to 4 rpm by six hydraulic motors, and the shield is moved forward by hydraulic jacks pushing against the last completed ring of the tunnel lining.▲▲



½″ Wire now engineered to put architectural design miles ahead...

turn page for story . . .

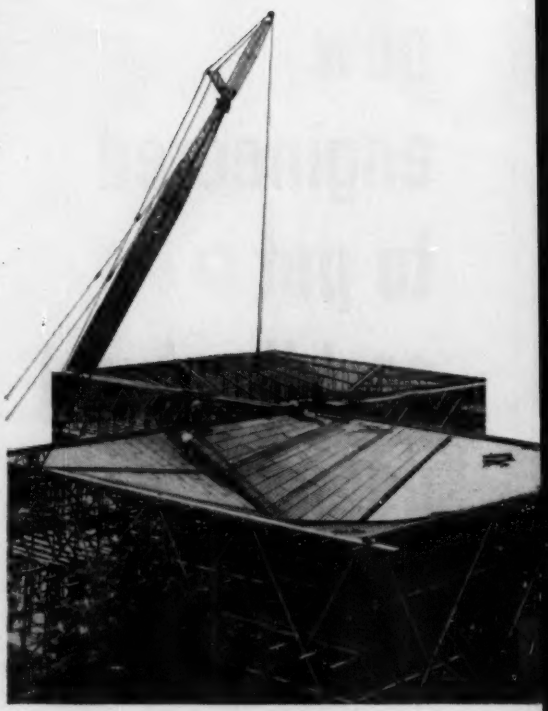
Now . . . extra-heavy ½″ USS American for design versatility and lower

IN THIN-SHELL HYPERBOLIC PARABOLOID ROOF, SAVES 6 DAYS' CONSTRUCTION TIME.

The thin-shell roof of the new library at Hunter College consists of six 60-ft. square inverted concrete umbrellas. They are joined at the edges to form a roof 120 ft. wide by 180 ft. long. Each umbrella is divided into four hyperbolic-paraboloidal quadrants.

Steel reinforcement for the "inside-out" umbrellas was provided by USS American Structural Welded Wire Fabric. Each umbrella used twelve 31′ x 10½′ Welded Wire Fabric mats.

Installation was easily and speedily made by a small crew. When the concrete work was completed it was found that the use of pre-fabricated steel fabric had actually saved labor and material . . . and construction time had been cut by six days!



Structural Welded Wire Fabric cost concrete reinforcement

IN THIN FLAT-PLATE FLOOR SLABS, SAVES 15 WORKING DAYS

This handsome 12-story apartment building at 209-223 East 53rd Street in New York City was the first to be constructed with heavy welded wire fabric for reinforcement of thin flat-plate concrete floor slabs. Flat slab floor framing was selected because: (1) the thin (5½″) flat-plate slab with its smooth surfaces unbroken by offsets for beams and girders, offers more ceiling height, and (2) it permits flexibility of partitioning and trims plastering and decorating costs.

Structural Welded Wire Fabric was selected to reinforce the slabs because the machine prefabrication of high yield strength steel wires offered: (1) Reduction in time and cost of handling 10′ x 20′ prefabricated wire fabric mats as opposed to placing and tying individual reinforcing members—a savings of 1½ days to 2 days per 140′ x 60′ floors . . . and with fewer lathers. (2) Assurance that steel will be placed where required. (3) Positive mechanical anchorage in the concrete to assure crack control. **USS American Structural Welded Wire Fabric is prefabricated with greater accuracy than can normally be relied upon in field work. This assures correct placement and distribution of the steel. The wires are drawn to the very close tolerance of plus or minus 0.003″.**

The new high tensile strength (75,000 psi minimum) and high yield strength (60,000 psi minimum) of USS American Structural Welded Wire Fabric permitted a higher working stress for fabric than would have been allowed by the building laws of the City of New York for hot-rolled bars.

See next page . . .

American Steel and Wire Division of United States Steel

Here's why job-tailored USS American Structural Welded Wire Fabric is your best concrete reinforcement

You can now get USS American Structural Welded Wire Fabric with ½" diameter wires spaced as close as 2" on centers in both directions! These new areas of steel, plus the many time-tested advantages of Welded Wire Fabric, make it the best structural reinforcement for all types of construction.

1. USS American Structural Welded Wire Fabric is made from **cold-drawn** high tensile steel wire. This wire is carefully produced to conform to the requirements of ASTM Specifications A82-58T. The minimum tensile strength is 75,000 psi and the minimum yield, as defined in the specifications, is 80% of the tensile or 60,000 psi. Actually, the cold drawn steel wire has no yield point in the conventional sense of plastic stretch at a constant load. Yield occurs gradually with increasing load beyond the 60,000 psi minimum. This physical advantage of cold-drawn wire makes it **the ideal concrete reinforcement.**

2. USS American Structural Welded Wire Fabric is completely machine prefabricated by electrically welding all intersections to conform to ASTM specifications. This high-strength connection assures positive mechanical anchorage in the concrete.

3. USS American Structural Welded Wire Fabric is prefabricated with greater accuracy than can normally be relied upon in field work. The wires may not vary more than ¼" center-to-center than the specified spacings. This assures correct placement and distribution of the steel. **Wires are drawn to the very close tolerance of plus or minus 0.003".**

4. USS American Structural Welded Wire Fabric requires very little on-the-job tying. Large prefabricated sheets are shipped to the job and placed as a unit. This eliminates thousands of ties and results in important savings.

For more information on the advantages and applications of American Structural Welded Wire Fabric, get in touch with our nearest Sales Office or contact American Steel and Wire, Dept. 1179, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

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Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
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United States Steel Export Company, Distributors Abroad

Presenting . .

Our Authors

Walter E. Lobo graduated from the Massachusetts Institute of Technology in 1926, and went on to do graduate work at Louisiana State University. From 1929 to 1957 he worked for the M. W. Kellogg Company, eventually becoming director of the Chemical Engineering Division. In 1957 he started working full-time as a consultant for petroleum and petro-chemical industries. Lobo belongs to various professional organizations, including AICE, AIChE, ASME, and ASEE. His article, on the ethical dilemmas involving the use of trade secrets and confidential information, starts on page 140.

Donald R. Goodkind, president of Goodkind & O'Dea, Inc., graduated from Cornell with a BS in civil engineering, and went on for his master's degree at the University of Illinois, also in civil engineering. He served in the U. S. Navy, and later was resident engineer on the New Jersey Turnpike. He is a member of NSPE, ASCE, and the Consulting Engineers Association of New Jersey, and is registered in Massachusetts, Connecticut, New York, New Jersey, Delaware, Ohio, and Illinois. Goodkind's article, on the value of a residence requirement in selecting a consultant, is on page 122.

William B. Ball, a project engineer with Kaiser Engineers, has been with Kaiser since 1941. He has been in charge of several major projects, including industrial plants, electrical power stations, dams, tunnels, and water distribution and treatment systems. Ball, a registered mechanical and civil engineer in California, has had an opportunity to apply computer scheduling techniques to the solution of problems on his various projects. His article on the use of digital electronic computers in engineering analyses, with specific application to the design of earth dams, begins on page 115.

Robert W. Richards received his second degree from Princeton 16 years ago, and since then has specialized in writing and editing technical material. In 1950 he joined the consulting firm of Howard, Needles, Tammen & Bergendoff as a highway engineer. Later, he became a report writer, and in 1956 was promoted to his present post as New York office manager. Richards is a Fellow of ASCE and is registered in New York and Pennsylvania. His first article for CONSULTING ENGINEER, on minimizing mistakes, drew numerous requests for reprints. His current article on coordination begins on page 129.

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Richard Sanders Allen is the son of a consulting engineer who specialized in highway and bridge design. Following his father on construction jobs interested Allen in engineering, and started him on his hobby of collecting pictures and information about early American engineering feats. In addition to previous features for CONSULTING ENGINEER on early bridges and tunnels, he has written books and articles for a number of magazines. His article on 19th century American inclined railroads is on page 133.

Paul Rogers came to this country from Hungary in 1939, after graduate study in civil engineering at Ecole du Genie Civil, Paris. He entered private practice in 1953, and now is president of Paul Rogers and Associates, Inc., and partner in the French firm of Bonnet and Rogers. He is a member of several professional organizations, including CACE, NSPE, and ASCE. Rogers has lectured at Northwestern and at the Illinois Institute of Technology. His article on prestressed steel is on page 138.

George F. Sowers received his BSCE from Case Institute of Technology in 1942, and a master's degree from Harvard in 1947. During World War II he worked for the TVA and served in the Navy. In 1947, Sowers organized the soils investigation and engineering department of the Law Engineering Testing Co., of which he is now vice president. In addition to his consulting work, he serves as professor of civil engineering at Georgia Tech. His article on earth dams begins on page 106.

Jerome Goodman graduated from the City College of New York with a degree in electrical engineering, and later received a master's degree from the same school. He has taught electronics and psychoacoustics at Columbia University since 1954, and operates a consulting office in New York, specializing in acoustics. He is registered in New York and is a member of NSPE and the American Institute of Physics. His article, on the problems created by noise in industry, is on page 125. ▲▲

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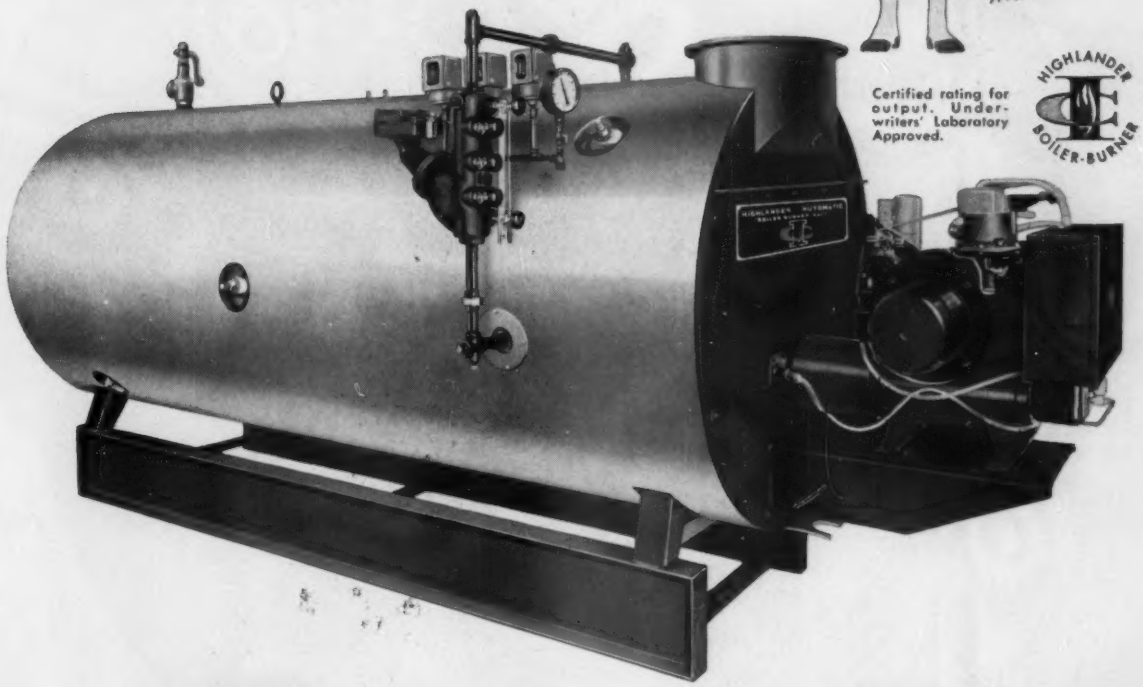

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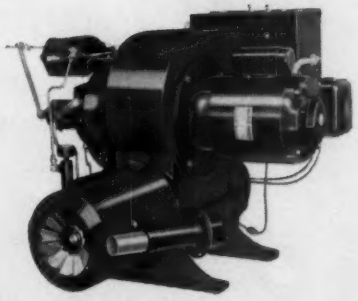

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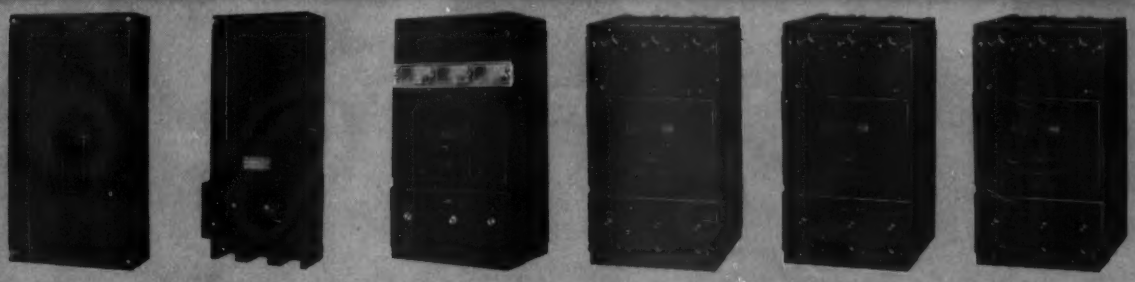

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The Readers' Guide

Coordination is Important
page 129

"Technical competence is no longer the only criterion for a qualified engineer." Robert Richards points out that the efficient utilization and assignment of personnel is a full-time job.

Residence Requirements
page 122

"Does the consultant maintain a local office?" Donald Goodkind examines the legal, moral, and practical aspects of residence requirements in the selection of a consulting engineer.

Earth Dam Failures
page 106

"Frequently, [earth dam] failure occurs long after the conditions which bring it about are initiated. This sometimes leads to false confidence in shoddy practices, which eventually charge the full price of ignorance and carelessness." George Sowers tells why earth dams occasionally fail, and how the failures can be prevented.

Prestressing Steel
page 138

"Obviously, any shape or form of steel structure may be subjected to prestressing." Paul Rogers discusses the advantages, limitations, and applications of prestressed steel.

Confidential Information
page 140

"There is one response that is always right but which is subject to extremely broad interpretation: 'Be ethical.'" Walter Lobo asks how much of his knowledge a consultant can use, legally and ethically.

Noise Attenuation
page 125

"Attention to the acoustic factors of construction is vital to the consulting engineer with an eye on future business." Jerome Goodman defines the scope of acoustics in engineering, and warns consultants of increasing legal restrictions on noise.

Opportunity in Africa
page 118

"There is reason to believe that these countries soon will develop economic stability, thus providing substantial opportunities for technologists and professional advisors." The Economist Intelligence Unit reports on the openings for consultants in East Africa.

The Digital Computer
page 115

"The digital electronic computer is not a panacea that will free all engineers from the drudgery of routine work." W. B. Ball describes the applications of computers to engineering analyses.

The First Inclined Railways
page 133

"Railroads of the 1830s which did not depend on canal connections also utilized the inclined plane with its hoisting apparatus." Richard Sanders Allen tells how our great-grandfathers got their goods, and themselves, up and over hills and mountains.

YARWAY Y news briefs

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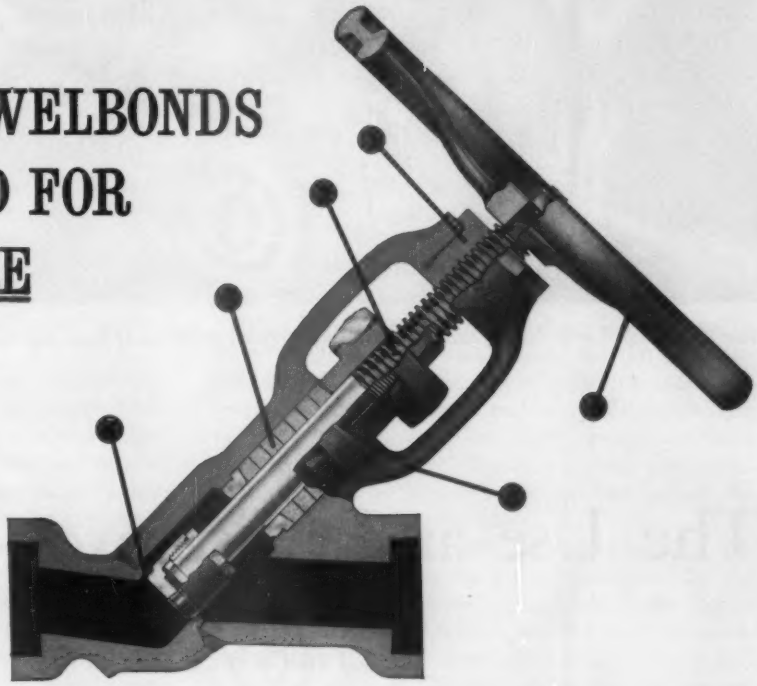

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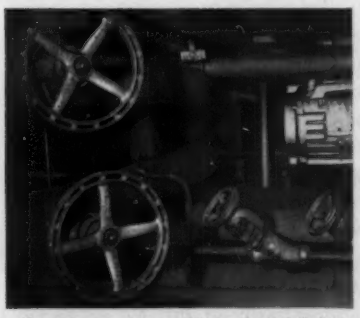
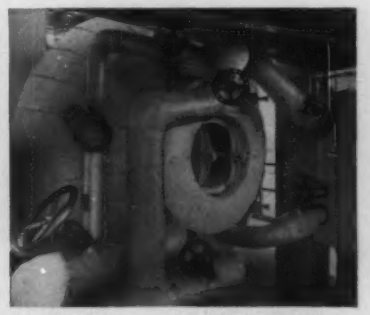


Four of many Yarway Welbonds installed in large eastern public utility plant. Steam pressure 1850 psi; temperature 1000°F.

Four Yarway Welbonds on main steam line to turbine at southern power plant. Press. 2310 psi; temp. 1000°F. Over 100 Welbonds here.



Six of 900 Yarway Welbonds at southwest utility. Boiler drum pressure in this plant—2150 psi; superheat temperature 1005°F.

The 300-ft high Lewis Smith Dam, designed for extreme conditions of flood and load. (Photo courtesy Alabama Power Co.)

The Use and Misuse of Earth Dams

GEORGE F. SOWERS

Law Engineering Testing Co.

"I BUILT IT LIKE THE BEAVERS, *with sticks and rock to reinforce it, with grass and leaves to make it tight; but still it broke.*"

The bulldozer operator-turned-contractor stared at the 20-ft wide gap in the 8-ft high dam. He repeated his excuse to angry residents, who had been startled by a sudden flood, washing out culverts and roads and damaging property for a half mile down the creek. He built the dam under contract to provide a fishing pond; all he had to show for his effort was several acres of soft clay and some dying fish.

CE *exclusive*

EARTH DAMS have had a long history of usefulness and durability. The earliest builders were probably the beavers — whose craftsmanship has long been recognized and emulated. Their dams may leak, but they are structurally sound.

Ancient man learned to build earth dams to conserve water even before he could read or write. Remnants of prehistoric earth dams can be seen today in many parts of the Middle East. Ancient engineers in India and Ceylon built large numbers of earth dams for irrigation. Some are as high as 60 feet, and several are more than a mile long.

Today, earth dams are storing water for irrigation, flood control, power, and public water supply in all parts of the world. The largest structure ever built is the Fort Peck earth dam, in Montana, which required 124 million cubic yards of fill. Recent earth

dams, 300 feet high and more, rank with the tallest of any type. The Lewis Smith Dam, of the Alabama Power Company, is an example of how modern rock and earth fill construction combines safe design with the economical use of local materials so that it becomes a fixed part of the countryside and a servant to the surrounding region.

Requirements for a Satisfactory Earth Dam

An earth dam, like all other engineering structures, must meet certain basic requirements. First, it must hold water. It must be sufficiently watertight to store enough water to serve its intended function. The inevitable leakage that does occur must not weaken or damage the dam or its foundation. Second, the dam must be structurally sound. It must have a margin of safety against failure from its own weight and from the maximum pressure of the water against it. Finally, there must be provision for bypassing the maximum excess flow of water without damage to the structure. Failure to meet any one of these requirements means an unsafe dam and potential failure.

The earth dam consists of three basic components; the foundation, the embankment or dam proper, and the spillway and control works. The foundation supports the load of the dam and the water, and it provides the watertight barrier for the bottom and sides of the reservoir. The dam proper closes the gap, supporting the load of the water and providing a continuous watertight barrier with the foundation. The control works and spillway deliver water from the reservoir to point of consumption below. In times of flood, water is bypassed directly from the reservoir to the stream so there is no danger of water passing over the earth embankment.

All three components work together to fulfill the requirements. A deficiency in one can lead to failure of another; failure of one means failure of the entire project, and the possibility of disaster.

Dam Failures

Unfortunately, there have been failures, and while they represent only a small fraction of all dams, the damage resulting from the failure of even low dams has been both spectacular and costly. This is illustrated by the collapse of a dam for a small fishing and swimming lake on a creek in the Blue Ridge Mountains of North Georgia. Although the dam was only 40 feet high, when the downstream face slid out the first time, the lake was full, and a wall of water 30 feet high burst into the narrow valley below. The bark was scoured from large trees by gravel carried in the water, leaving naked white trunks to mark the high water line. A cornfield was blanketed with a layer of gravel and clay which destroyed the crop and left it barren. A gas station and three cottages of a small summer resort were demolished a half mile below the dam. Finally, the flood washed through a chicken farm killing 50,000 broilers.

Fortunately, no humans were killed because the collapse took place in May before the cottages were occupied, and the gas station attendants were able to run to high ground before the water struck. The damage far exceeded the value of the dam or that of the land on which it was built, and law suits stemming from attempts to collect damages from the dam's owner and his contractor are still in the courts.

Similar failures occur every year, particularly during periods of heavy rainfall. Newspapers reported the collapse of a number of small dams near Franklin, Virginia, following the hurricane of September 1960. These flooded part of the town, damaging homes and isolating over 100 families. A reservoir in the phosphate mining area of Central Florida burst in the summer of 1960, and two small dams just north of Tampa, Florida, failed during the spring rains, flooding residences and damaging streets.

Bitter experience is a demanding teacher, and a study of the ways in which dams can fail offers an instructive approach to design problems. An engineering failure is a serious matter, involving not only the loss of the structure but injury or death to those who occupy it. Failure of a dam is even more catastrophic, because the water released may spread destruction downstream for miles.

The greatest loss of life in any disaster in the United States (except for war) was caused by the failure of an earth dam near Johnstown, Pennsylvania, in May 1889. The 72-ft high embankment was overtopped after a period of heavy rain, and washed out. A wall of water 40 feet high descended the narrow, steeply sloping canyon, joining the main river which already was badly swollen from the previous rains

Gravel scour in a 15-ft high wall of water from a bursting dam scraped the bark and the roots from these trees.

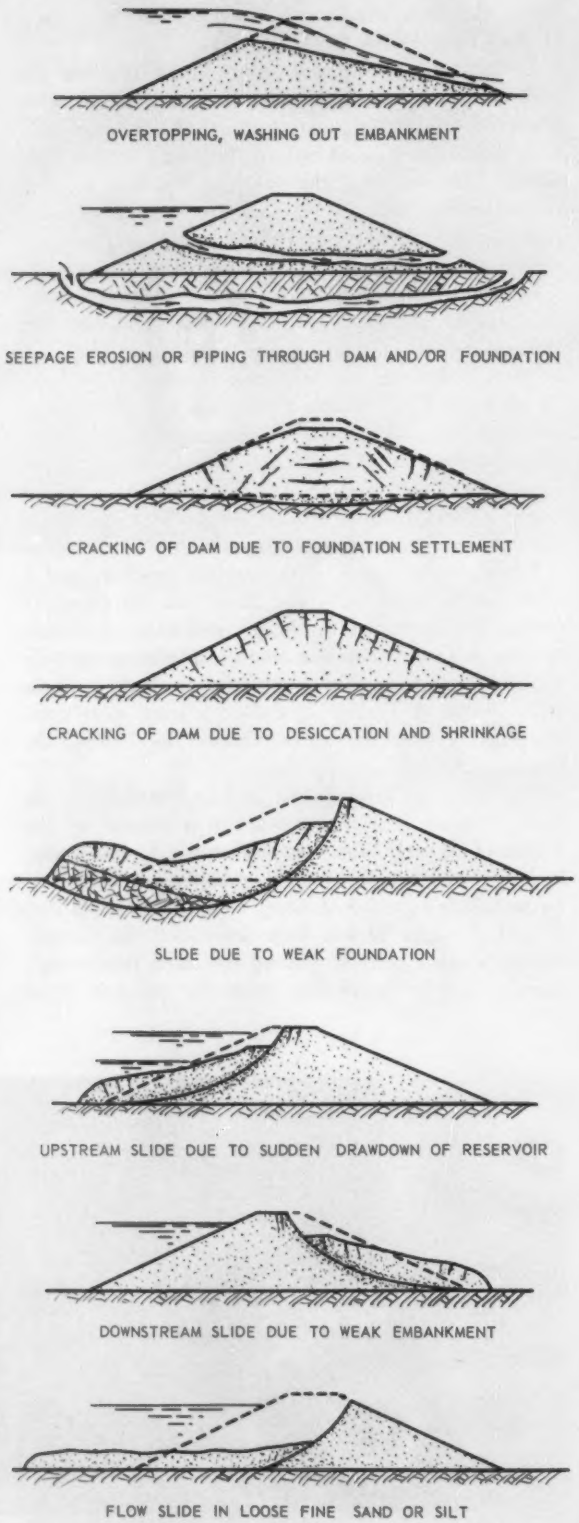

OVERTOPPING, WASHING OUT EMBANKMENT
SEEPAGE EROSION OR PIPING THROUGH DAM AND/OR FOUNDATION
CRACKING OF DAM DUE TO FOUNDATION SETTLEMENT
CRACKING OF DAM DUE TO DESICCATION AND SHRINKAGE
SLIDE DUE TO WEAK FOUNDATION
UPSTREAM SLIDE DUE TO SUDDEN DRAWDOWN OF RESERVOIR
DOWNSTREAM SLIDE DUE TO WEAK EMBANKMENT
FLOW SLIDE IN LOOSE FINE SAND OR SILT

Fig. 1 — The major forms of structural, hydraulic, and seepage conditions which cause failures in earth dams.

and beginning to flood the valley above Johnstown. The wall of water, 10 feet above the swollen river, demolished houses, tore down factories, and wrecked bridges. It finally piled up the wreckage with its cargo of dead and injured against a stone arch bridge. The debris caught fire and incinerated both dead and living. Over 2200 bodies were recovered, some of them being unearthed from the rubble as much as 10 years after the flood.

It is difficult to identify the causes of such a dam failure because the evidence often is destroyed by the swiftly moving water. However, by painstaking study it is usually possible to piece together the events leading to failure and to point out the most likely causes and the contributing factors.

Three different types of failure occur: hydraulic, seepage, and structural. Each can take place independently of the other, although they often are interdependent. Each can occur in a number of different forms (Fig. 1) depending on the part of the structure affected and the forces responsible.

Hydraulic Failures

Hydraulic failures involve the erosion of the surface of the embankment and account for nearly a third of all disasters. No soil is erosion resistant, and even a small but steady flow of water can wash out large quantities of materials. Obviously, a larger flow will wash out more material and do it faster.

The most frequent form is overtopping or a flow of water across the top of the dam. Dams of sand can be destroyed in a few minutes by such a flow, while some clays can withstand a depth of flow of a foot or two for several hours. The failure of the dam which caused the Johnstown flood was preceded by a flow over the crest for more than two hours before the final collapse. Overtopping usually is caused by an inadequate spillway – too small a capacity for the flood water that always occurs.

A 50-ft high dam for a farm reservoir, near Ackerman, Mississippi, washed out completely following a prolonged rain. The final collapse was precipitated by the overtopping failure of a 15-ft high dam immediately upstream. The spillways for both dams were little ditches cut around the ends of the embankments and only slightly larger than the dry weather stream bed. The failure of the dam above Johnstown also was caused by too small a spillway, which was partly blocked by debris that accumulated on screens designed to prevent loss of fish.

Insufficient height of embankment above the spillway further increases the hazard of overtopping, especially if wind piles up water against the dam or if waves add to the water height. Settlement of the dam caused by a compressible foundation or inadequate compaction of the embankment can reduce the freeboard after construction is finished. Since

the settlement occurs slowly, it seldom is noticed until the water laps at the crest.

The lapping of waves on the upstream face and the action of currents about spillways can notch the dam and weaken the embankment structurally. Erosion from rainfall can produce gullies which, if unchecked, can lead to overtopping or structural failure.

Seepage Failures

Seepage of water through the embankment or foundation is responsible for more than a third of all failures. Some seepage is inevitable in all dams, and when it is controlled it does no harm. Uncontrolled seepage can lead to excessive loss of water from the reservoir or to seepage erosion and a hole through the dam.

Excessive seepage loss frequently comes from pervious seams, or even cavities in the foundation. For instance, leakage beneath a small earth dam on a porous limestone foundation was so great that the stream banks downstream resembled small waterfalls. Water boiled up in the stream bed several hundred feet downstream, and wet areas developed in the property below the dam, making it unfit for agriculture. The condition grew progressively worse until expensive repairs were necessary to prevent total destruction of the project.

Excessive leakage through the embankment is caused by highly pervious soils, debris, and poor compaction. Usually, this leads to internal erosion and hydraulic failure. Leaks often develop in conduits through the embankment due to deterioration or settlement. The cracking of the cast iron outlet for an old water supply dam caused leakage that finally washed a hole through the embankment and drained the reservoir overnight. Occasionally, excessive seepage loss has been caused by cracks in the dam produced by settlement. Drying of clay dams that were exposed by prolonged low water level in the reservoir also has produced cracks and excessive seepage.

Water seeping out of the soil on the downstream side of the dam or its foundation may carry with it a small amount of soil. This creates a small pit in the soil, which acts as a collector that concentrates the seepage at this point. The result is increased erosion, and a deepening and enlarging of the pit into an open conduit or pipe. As erosion continues, the pipe becomes deeper, progressing upstream toward the reservoir. The closer it gets, the shorter the seepage path, the greater the flow of water, and the worse the erosion. Finally, a continuous open pipe forms, upstream to downstream. Water courses through it, rapidly enlarging it.

One such pipe in a 30-ft high municipal recreation dam was more than 15 feet in diameter. Previous to this, slow seepage and the formation of small sand boils at the downstream toe had been observed for more than a week, but since nothing more spectacular had occurred the city officials were not concerned. One morning the chief of police found the lake gone and a hole big enough to drive an automobile through. Instead of seeking professional help, the mayor instructed the police chief to find the cause of the water loss. His contribution to engineering science, after a long investigation, was that the lake disappeared because the dam had a hole in it.

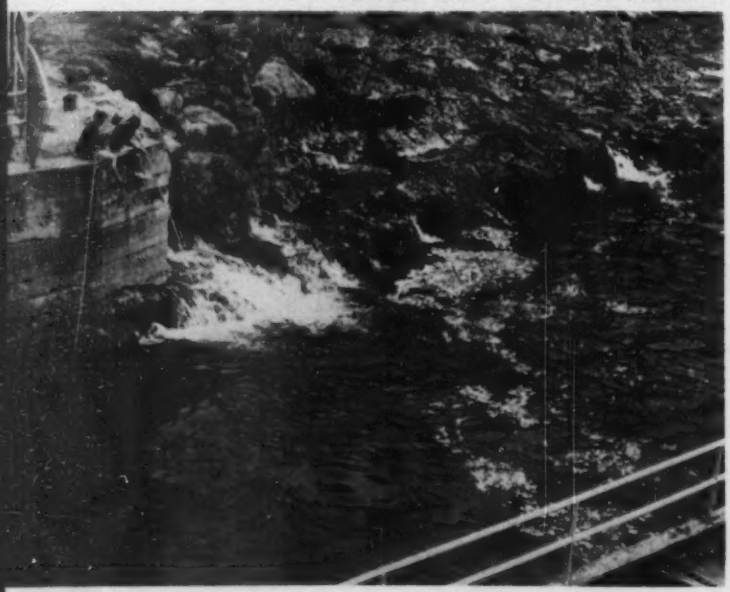
Fine sands, silts, and poorly compacted soils are particularly sensitive to seepage erosion. The same leakage that causes excess water loss often leads to erosion, even though the amount of seepage may be too small to notice. Piping can be caused by concentration of seepage along roots, rock, and debris in the embankment, or on the boundary plane between the dam and its foundation. The real cause of the failure of the aforementioned dam was a

Overtopping – usually the result of inadequate spillway provision – caused the failure of this 15-ft high dam.

Rainfall erosion of an unprotected dam. Repeated erosion – even from light rain – can wash out an unprotected dam.

Slide in the upstream face of a dam. These slides are caused by sudden lowering of the water level in the reservoir.

Piping failure in an earth dam. The 15-ft hole in this dam started as a small erosion pit on the downstream face.



Downstream seepage. The water pouring out of the stream banks is from a dam on a porous limestone foundation.

layer of roots and topsoil that the contractor had neglected to strip away before starting to place the embankment for the dam.

In rare instances, animal burrows, such as those made by the muskrat, have triggered seepage erosion. In one earth dam, 14 such holes were counted in a distance of 300 feet, just below the water surface on the upstream face.

Structural Failures

Structural failures or sliding of the embankment and the foundation are responsible for about one third of all disasters. They take place when the stresses in the soil produced by the weight of the dam or the load of water on it exceeds the strength of the soil. Any combination of circumstances that causes an increase in the loads, or a decrease in soil strength can lead to failure. Frequently, surface erosion and uncontrolled seepage, though they may not produce failure on their own account, can cause weakening of the soil and a structural failure. However, in other situations inherent weaknesses in the dam are alone responsible for trouble.

Some slides include both the dam and its foundation. A small dam was designed to convert a wide, swampy river bottom to a shallow fishing lake. It was under construction and had reached a height of about 12 feet when it suddenly sank into the foundation. Waves of soft mud pushed up on both sides of the dam, beyond what had been the toes of the fill, and they rose even higher than the original embankment. Smaller waves parallel to but farther from the dam appeared. An investigation disclosed that the foundation consisted of a 3-ft thick crust of hard clay, underlain by a 50-ft thick deposit of very soft clay which filled a prehistoric creek channel. The crust supported 11 feet of dam but broke with 12 feet, forming a deep seated shear slide along a curved failure surface resembling an egg shell sliced in half lengthwise. Such failures usually occur during construction, splitting the embankment on either the upstream or downstream side, or simultaneously on both sides. They always are accompanied by a subsidence of the top of the embankment within the failure zone and the formation of a mud wave beyond the toe.

Thin seams of sand and silt in the foundation, which are connected to the reservoir, can build up water pressure and create a plane of weakness in the foundation. Horizontal sliding may take place on this surface, which pushes up broad mud waves and splits the embankment, often with little subsidence. These failures ordinarily occur on the downstream face of the dam some time after the reservoir is filled.

Slides can take place in either the upstream or downstream face of the dam above the foundation. Upstream slides usually occur during or immediately

after a sudden drawdown of the reservoir level. A leaking conduit in a water supply dam created a small piping failure that lowered the water level in the reservoir 20 feet overnight. This created a series of slides in the upstream face of the dam. A number of crescent shaped segments on the top of the dam subsided and deep cracks appeared in the top of the dam parallel to and behind the failures. The soils at the bottom of the slope pushed out across the foundation in big bulges filled with cracks. By chance, one of the slides occurred at the exact location of the pipe, and it sealed off the opening, preventing further leakage.

Similar upstream slides have followed the rapid lowering of water levels during flood control operations. The cause is the rapid increase of the stresses in the soil. When the slope is inundated, the soil is partially supported by buoyancy. When the water level is lowered suddenly the buoyancy disappears. The waterlogged soil shears when deprived of the support provided by the water.

Downstream slides are similar in appearance to those on the upstream face. Usually they occur during the first filling of the reservoir or following unusually heavy rains or abnormally high reservoir levels. The downstream face of a 50-ft high recreation lake dam slid following a period of prolonged intense rainfall. A broad segment of the dam crest subsided in several successive failures, creating giant steps below the top. The lower part of the slope bulged upward, and small springs and wet spots appeared in the surface. In this instance, abnormal seepage through the dam combined with high rainfall to saturate the downstream face. The soil had not been compacted properly, and the water weakened the soil until it no longer could support itself.

The failure of this recreation dam commenced with a slide in the downstream face. The contractor made no attempt to clear the foundation or remove debris from the borrow pit; consequently, the fill contained pockets of boulders and nests of tree stumps, roots, leaves, and branches. The earth was not compacted and quickly became saturated from the excess seepage that worked its way through the large voids created by roots and rocks. The downstream face failed when the reservoir was still seven feet below the spillway.

Slides in both the upstream and downstream faces have similar characteristics. A crescent shaped segment subsides, and the lower part of the slope bulges outward and up, sometimes moving outward across the foundation. Cracks parallel to the failure appear

Failure of a 50-ft high recreation dam. The failure was caused by a slide in the downstream face, following a heavy rain.

TABLE 1 — EARTH DAM FAILURES

Form	General Characteristics	Causes	Preventive or Corrective Measures
		Hydraulic Failures (30% of all failures)	
Overtopping	Flow over embankment, washing out dam	Inadequate spillway capacity	Spillway designed for maximum flood
		Clogging of spillway with debris	Maintenance, trash booms, clean design
		Insufficient freeboard due to settlement, skimpy design	Allowance for freeboard and settlement in design; increase crest height or add flood parapet
Wave erosion	Notching of upstream face by waves, currents	Lack of riprap, too small riprap	Properly designed riprap
Toe erosion	Erosion of toe by outlet discharge	Spillway too close to dam	Training Walls
		Inadequate riprap	Properly designed riprap
Gullying	Rainfall erosion of dam face	Lack of sod or poor surface drainage	Sod, fine riprap; surface drains
		Seepage Failures (40% of all failures)	
Loss of water	Excessive loss of water from reservoir and or occasionally increased seepage or increased ground water levels near reservoir	Pervious reservoir rim or bottom	Blanket reservoir with compacted clay or chemical admix; grout seams, cavities
		Pervious dam foundation	Use foundation cutoff; grout; upstream blanket
		Pervious dam	Impervious core
		Leaking conduits	Watertight joints; waterstops; grouting
		Settlement cracks in dam	Remove compressible foundation, avoid sharp changes in abutment slope, compact soils at high moisture
		Shrinkage cracks in dam	Use low plasticity clays for core, adequate compaction
Seepage erosion or piping	Progressive internal erosion of soil from downstream side of dam or foundation backward toward the upstream side to form an open conduit or "pipe." Often leads to a washout of a section of the dam.	Settlement cracks in dam	Remove compressible foundation; avoid sharp changes; internal drainage with protective filters
		Shrinkage cracks in dam	Low plasticity soil; adequate compaction; internal drainage with protective filters
		Pervious seams in foundation	Foundation relief drain with filter; cutoff
		Pervious seams, roots, etc. in dam	Construction control; core; internal drainage with protective filter
		Concentration of seepage at face	Toe drain; internal drainage with filter
		Boundary seepage along conduits, walls	Stub cutoff walls, collars; good soil compaction
		Leaking conduits	Watertight joints; waterstops; durable materials
		Animal burrows	Riprap, wire mesh
		Structural Failures (30% of all failures)	
Foundation slide	Sliding of entire dam, one face, or both faces in opposite directions, with bulging of foundation in the direction of movement	Soft or weak foundation	Flatten slope; employ broad berms; remove weak material; stabilize soil
		Excess water pressure in confined sand or silt seams	Drainage by deep drain trenches with protective filters; relief wells
Upstream slope	Slide in upstream face with little or no bulging in foundation below toe	Steep slope	Flatten slope, or employ berm at toe
		Weak embankment soil	Increased compaction; better soil
		Sudden drawdown of pond	Flatten slope; rock berms; operating rules
Downstream slope	Slide in downstream face	Steep slope	Flatten slope, or employ berm at toe
		Weak soil	Increased compaction; better soil
		Loss of soil strength by seepage pressure or saturation by seepage or rainfall	Core; internal drainage with protective filters; surface drainage
Flow slide	Collapse and flow of soil in either upstream or downstream direction	Loose embankment soil of low cohesion, triggered by shock, vibration, seepage, or foundation movements	Adequate compaction

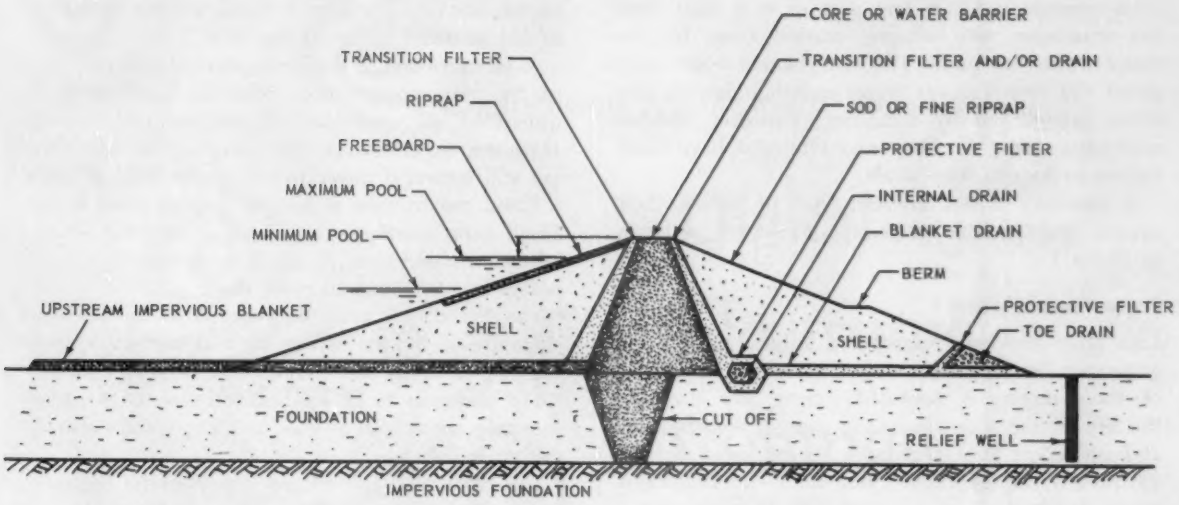


Fig. 2 – This cutaway view of an earth dam shows the deceptively complex composition of an apparently simple structure.

Cracks in crest of an earth dam. Unless preventive measures are taken immediately, this dam probably will fail.

in the remaining top of the dam, and cracks both perpendicular and parallel to the failure zone can develop in the bulges. Though most slides are caused by sudden draining on the upstream face and saturation of the downstream face, they can occur in either face during construction if the soil is weak, the design is skimpy, or the soil is not properly and adequately compacted.

In all the previously described slides the soil shears along a more-or-less well defined curved surface. The soil within the failure zone moves, but remains relatively intact during the process. However, in flow slides the soil within the failure zone suffers a structural collapse. It suddenly flows like a viscous liquid, completely destroying its original form and coming to rest far from its original position.

The failure of a long low power dam in North Florida was at least partially by flow. The earth embankment, over a half a mile long and 30 feet high, was constructed in the 1920s by dumping fine sand from railroad trestles. Although the sand was quite loose, it stood without incident for 30 years. During a period of unusually high rain following two months of wet weather, two sections of the dam with a total length of 1800 feet simultaneously collapsed, draining the reservoir and flooding the valley below. Two men who were fishing on a bridge a half mile downstream were trapped and had to climb trees to avoid being washed away, and a number of small cottages were destroyed.

Flow slides occur in cohesionless sands and silts that are loosely deposited and that become saturated. As long as the soil particles are undisturbed, like oranges piled up one directly on top of another, the

mass appears rigid. If any part of it is disturbed, the remainder will collapse, carried away by the water within the pores. The disturbances which triggered the twin failures were probably downstream slides brought on by saturation. However, sudden saturation alone, or shock and vibration have been known to induce flow slides.

A summary of the different types of failure, their causes, and possible corrective measures, is given in Table 1.

Prevention of Failure

Like other accidents, earth dam failures usually are generated by ignorance and carelessness. If either of these factors is tolerated during any stage in the life of the dam, including design, construction, and operation, the stage may be set for a failure. Frequently, failure occurs long after the conditions which bring it about are initiated. This sometimes leads to false confidence in shoddy practices, which eventually charge the full price of ignorance and carelessness.

While an earth dam outwardly appears to be simple, internally it is a complex structure (Fig. 2). Each part must be designed to fit the local site conditions and the properties of the materials locally available for construction. The foundation supports the dam and its water load, and provides the water barrier for the bottom and sides of the reservoir. If it is not strong enough, the weak materials must be removed or stabilized. If it is pervious, a cutoff built through it to impervious soil or rock may be necessary; or the reservoir bottom and the upstream part of the foundation can be blanketed with an impervious soil that will hold the water. When the foundation contains pervious seams that possibly may not be sealed, internal drains located downstream from the cutoff and relief wells placed below the toe can relieve excess seepage pressures and prevent piping, which might otherwise destroy the dam.

The embankment serves as a barrier and support for the water. When a strong impervious soil is available, the entire dam may consist of the same material. More often, the embankment consists of an impervious core supported by a strong but more pervious shell. Internal drains often are necessary in the downstream shell to remove water which seeps through the core and which infiltrates from rainfall. These can be in the form of a blanket against the core, a continuous blanket on the downstream foundation, a trench or mound just downstream from the core, or a mound at the toe. The size and configuration of the drains depend on anticipated seepage, available materials, and character of the foundation.

Riprap protects the upstream face against wave attack and sod or riprap prevents rainfall erosion on the downstream face. Berms are sometimes placed on the downstream slope to catch surface runoff and to aid in maintenance of the dam.

A safe economical design requires the highest level of technical competence. Scientific analysis is required of all conditions of seepage and loading. However, experience is also necessary because there are still technical uncertainties in this field of work.

Good construction is just as vital as good design. Small dams, particularly, are too often built without adequate supervision. Here are some important check points in evaluating an earth dam:

¶ The foundation must be checked to be sure that there are no hidden defects such as cavities, springs, pockets, or seams that could weaken the structure.

¶ The materials to be used must be tested to insure that they are at least as good as those upon which the design is based.

¶ The placement and compaction must be inspected and control tests performed to be sure all components are in place and the soil adequately compacted.

Inspection and maintenance after the dam is in operation are just as important for dams as for any machine or structure. Many of the conditions that lead to failure exhibit warning signs long before the situation becomes dangerous, and corrective measures can be taken. It is important that:

¶ Immediately after construction and at regular intervals afterwards, the dam should be examined for cracks that are produced either by settlement or the beginning of shear slides. These cracks usually appear first at the top of the dam or in the slope near the top.

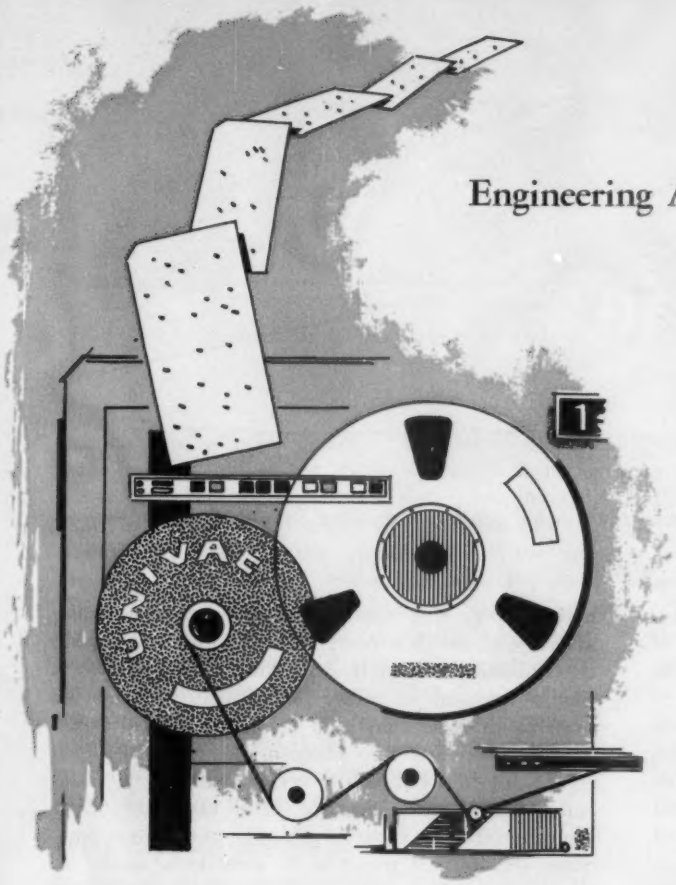
¶ The downstream face and the foundation should be examined regularly for seepage and wet spots, springs, and sand boils, particularly after long rains. Often these are worst just above and below the downstream toe, but sometimes they are discovered at great distances from the dam.

¶ The discharge from the internal drains should be measured, and checked for solid matter. Any noticeable increase of drain flow with a constant reservoir level or abnormal movement of solids is apt to be an indication of erosion.

¶ The upstream face should be examined for wave cutting and the downstream slope for rain erosion.

¶ The elevation and alignment of the top of the dam should be measured at intervals of one to two years to check on movement in embankment of foundation.

Continued maintenance is essential. Grass on the slope and the foundation adjacent to the dam should be kept cut so that it is possible to see any cracks and wet areas that might indicate trouble. Trees and shrubs must be kept from growing in the dam because their roots can open cracks and paths for seepage. Animal burrows should be filled, and riprap and grass replaced where necessary. Finally, all defects found in inspections must be repaired immediately to prevent progressive deterioration. ▲▲



Engineering Applications for . . .

Digital Electronic Computers

W. B. BALL
Kaiser Engineers

DESPITE ITS many advantages, the digital electronic computer is not a panacea that will free all engineers from the drudgery of routine work. Many of us can recall the introduction of plastics — spoons that melted in our coffee, plates that curled up like a tortilla, film that exploded like an incendiary bomb — misapplications galore. This possibility also exists in the field of computer application. While it is necessary for all of us to approach this new engineering tool with hope and imagination, we should not blindfold ourselves to the frailties and pitfalls of human nature, sometimes wrongly attributed to the computer. A thorough and adequate education in the equipment and its proper application will enable the engineer to take advantage of a tool which can revolutionize his approach to new and old problems alike.

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Stability Analyses on Earthfill Dams

Kaiser Engineers has make extensive use of electronic computer techniques. A good example is the development of a program to aid in the computation of slope stability analyses on earthfill dams. In a problem of this sort, the stability of the earth structure can be evaluated by use of the modified Swedish slip-circle analysis. Fig. 1 illustrates a simplified form of dam, with forces indicated at radial points along the arc of the circle under investigation.

The driving forces along the circle are made up of horizontal and vertical components. They are resisted by similar components within the material of the dam. The driving forces are illustrated by the heavy solid lines, while the resisting forces are illustrated by the heavy broken lines. The manual computation of these forces requires a considerable amount of time for each circle investigated.

The engineer may proceed by choosing a circle, making the necessary calculations, and analyzing the results in order to determine what other locations may require investigation. This can become a time-consuming process, particularly when different combinations of materials are being tried and many circles require investigation to determine the point of minimum safety factor against failure. If the engineer can develop a computer program so that his computation of each circle is reduced to a matter of minutes instead of hours, he obviously can investigate a great many more circles. The result is either a faster solution or the use of the computer-earned time to make a more detailed study.

Programs have been developed for solution of the Swedish slip-circle analysis, but generally these pro-

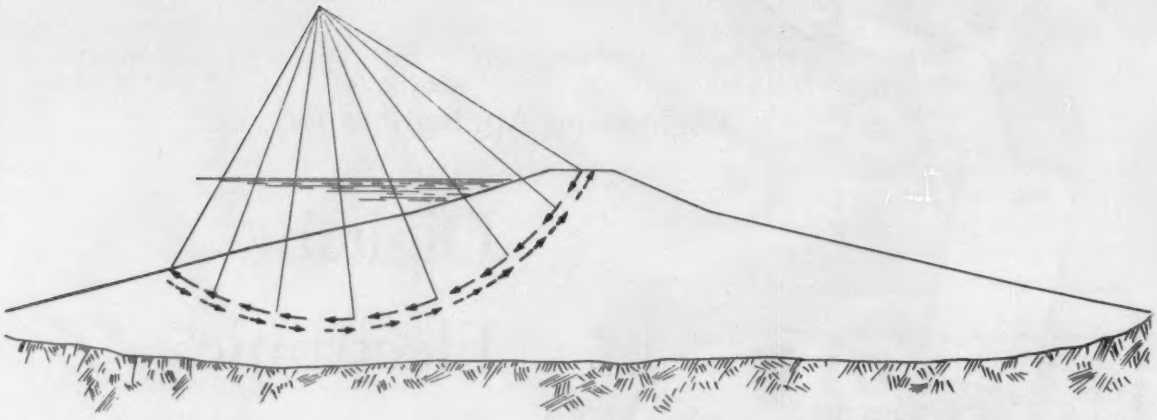


Fig. 1 — A simplified dam drawing, showing the forces at the radial points in a modified Swedish slip-circle analysis.

grams are limited by the number of materials which they can accommodate or by other considerations of design requirements. Because several projects were in prospect, Kaiser Engineers' designers undertook to develop a more complete program. It was not easy to take into consideration the multitude of variables, both in materials and in such conditions as degree of saturation and seismic activity, but the final program was a justification of all the effort that went into it. This stability analysis is now a common application for Kaiser's UNIVAC Solid-State 80 Computer.

It is possible, with this new program, to consider almost any number of materials in the embankment, to take into consideration the effects of saturation as represented by flow diagrams, and to accommodate several strata of foundation materials — all in the same program in a single run. An example of such a complex structure is shown in Fig. 2. The program may be set up to search out the location of the center of that circle which represents the minimum safety factor condition for a given embankment. It is very often preferable, however, to select a group of circles and compute the results for review prior to going ahead with further computation. Either immediate determination of the best location of a circle or a plot of contours of safety factors may be made so that the designer may zero in on the critical point. The engineer has two choices. He may do a job equivalent to what he formerly could do by hand calculation in much less time, or he may study additional variables or varieties in design in the same time. Since the desired result is to provide a saving in construction cost for the client, it would appear that the second choice is always the best. However, the engineer must make some profit on his work, and he therefore is faced with the necessity of modifying the approach so that both he and the client can profit from the new techniques.

On one Kaiser project, the materials of construction were not of the best quality, and, since it was desired to use materials in the immediate vicinity of the project for economy, the computer program was used to make more investigations of different combinations of the available materials than would

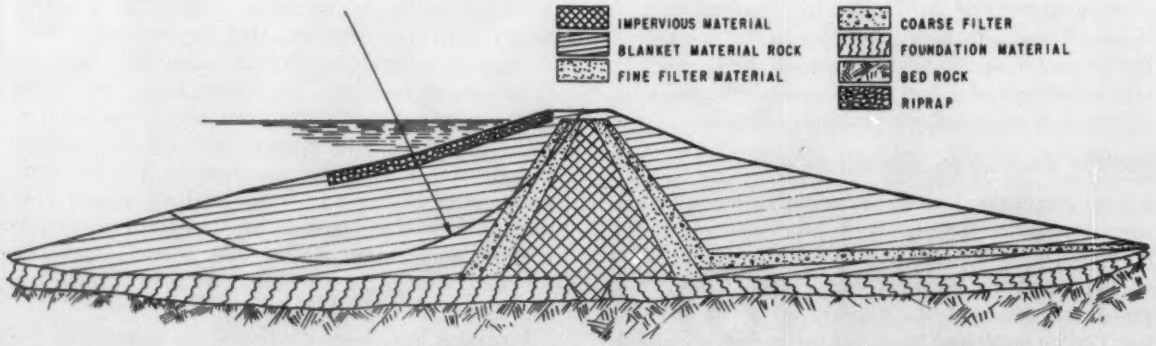


Fig. 2 — An example of the many foundation and structural materials that can be considered in one computer run.

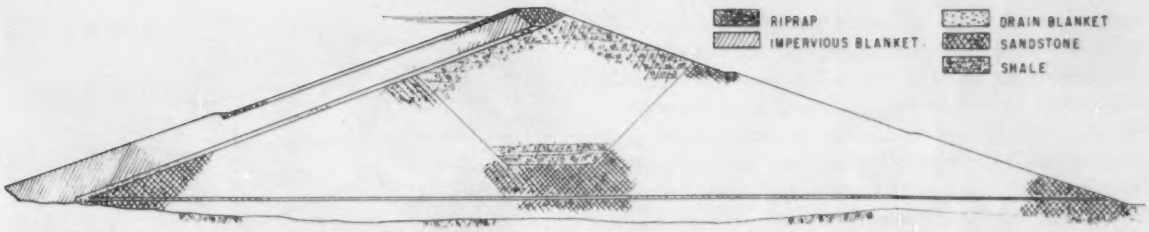


Fig. 3 — A computer can be programmed to make investigations of the different combinations of available materials.

ordinarily have been possible. The result of this work is illustrated in Fig. 3. It is evident that the rather unusual application of the core material, which is normally somewhere in the interior of the embankment, led to the application of the impervious material to the upstream face of the dam. The number of analyses run on this project was far in excess of that which ordinarily could have been attempted by a desk calculator. This more comprehensive analysis was completed without increasing the cost to the client. In fact, the savings on the over-all cost of the project were significant, mainly because it did not become necessary to import materials of construction to obtain a safe structure.

Other Computer Applications

Numerous other applications of Kaiser's UNIVAC have been made. One such application is the evaluation of the most economical type of ship to be used for shipment of bulk products overseas. A mathematical model of the problem was defined, and an almost infinite variety of ships, capacities, costs, and speeds was considered. Basic curves were developed from which the client was able to select the most desirable combination. The net result was a saving in the cost of the study and a much more valuable collection of information for the client.

Another direct application of the computer occurred while Kaiser engineers were studying the huge Volta River project for the government of Ghana. Since this involved new transmission lines and a study of the a-c load flow, it was decided to put the study on a computer program. The total time for this work was about one-thirtieth of that which might have been required for a manual calculation, assuming that anyone could have prepared such a study with the degree of accuracy and with the amount of data which was available without the use of a computer. On this program, it is obvious that the advantages of shorter study time and more information were realized for the client.

Perhaps the most interesting application of Kaiser's computer occurred in the course of a complex and advanced study on nuclear power development. The detailed problems are too numerous to consider individually, but one of the most significant was the transient temperature study for stress analysis of various reactor elements. Such a large group of variables existed in this problem that it would have been virtually impossible to prepare an adequate manual study of the desired information. Many typewritten pages of results enabled the engineer to determine accurately the critical points and conditions for which he was searching. It was our experience in this work on the nuclear reactor problems that a great deal of original information was developed because studies were made possible by the computer which were not previously possible or practical with manual calculation.

Critical Path Scheduling

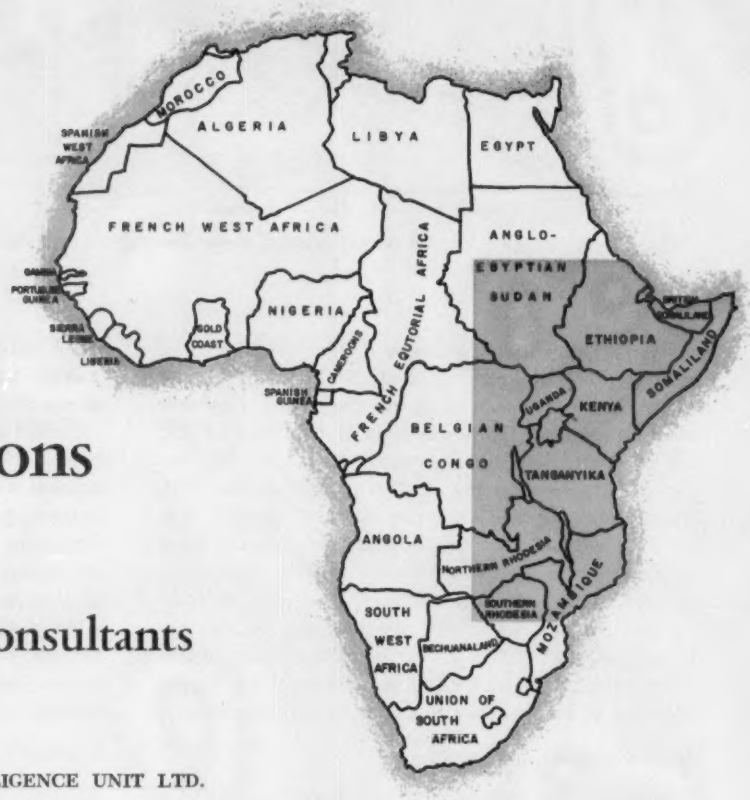
An important development in computer technology is referred to as critical path scheduling. This technique has been applied on various projects and is technically suited to such complex schedules as the State of California Water Plan, studies of rapid transit development plans, and the Volta River project.

Everyone is familiar with the old standby, the bar graph; and probably everyone is familiar with that vague, uneasy feeling that there may be something not taken into account. Critical path scheduling offers a technique which takes into consideration in a definite, foolproof way any number of variables which the scheduler feels should be applied to the project. The scheduler can feel confident that as long as an item is considered, its affect on the over-all schedule will be evaluated by the computer. This is in contrast to the bar graph approach, where very often it is found that two widely separated activities, requiring identical equipment or personnel, have been scheduled for the same day. Interestingly enough, even very simple schedules can be evaluated by the critical path method with a significant saving in time.

Many other applications of the computer have been made by Kaiser Engineers. They include computations for earthwork quantities for estimating and progress payments, profitability calculations, optimization of steel plant operations, and detail computation of column and beam stresses in repetitive structures. ▲▲

East Africa's New Nations

Prospects for Consultants



THE ECONOMIST INTELLIGENCE UNIT LTD.

THE RAPID PACE of political development in the three countries of British East Africa – Kenya, Uganda, and Tanganyika – has tended to obscure their slower rate of economic development. Because foreign investors hesitate over the uncertain outcome of political activity, these political changes are, for the time being, an obstacle to new undertakings in the economic field. But this will not always be so; there is reason to believe that these countries soon will develop economic stability, thus providing substantial opportunities for technologists and professional advisors who are not from the mother-country.

CE exclusive

At present, the East African territories provide only a limited field for British consulting engineers, and less still for non-British ones. This is caused by two main factors:

¶ Most engineering projects in these countries are still comparatively elementary ones – roads, railways, factories, and public buildings. Although several bigger and more complex projects have been proposed, the majority of them have had to await the extension of transport systems and other services, and the provision of adequate funds.

¶ Most engineering activity in these countries is, to a greater or lesser extent, government-financed and government-run. Careful schemes have been drawn up, and are being carried out for the most urgently needed engineering works in the three countries. Obviously, a strict order of priorities and a careful program of expenditures has to be maintained. Moreover, with certain exceptions, the supervision and execution of government-financed projects are, wherever possible, entrusted to government engineers.

Public Works

Roads are easily the most important type of public work now in progress in these countries. In the next three years, Kenya will spend about $17 million on roads, including a large scale bituminization of trunk roads. Tanganyika, which has only about 500 miles of bituminized roads, plans to spend $4.5 million a year on road works. Uganda, the smallest of the three countries, is reconstructing the roads between main towns and building a bridge over the Nile.

Kenya's road program is on the biggest scale, and provides a number of variations on the theme of financing and organizing public works in East Africa. Main roads in Kenya are the responsibility of the Road Authority, which controls policy and decides priorities and the allocation of money. However, local roads are outside its control, and are supervised by

The three new nations of East Africa. Note their proximity to the politically unstable nations of Central Africa.

local government bureaus. Although a statutory government-appointed body, the Authority includes several private individuals among its members.

The Road Authority receives about $5 million a year from vehicle licenses and similar fees, plus about $300,000 from the Central Government. Obviously, this is not nearly enough to finance large-scale road development, and the three main sections of the current road program have three different sources of capital behind them.

¶ The biggest section is a $12 million program, based on a contractor-financed scheme, by which the contractors raise the necessary funds on behalf of their client so that they themselves can be paid. The contractors concerned in this scheme are Mowlems (United Africa Company) and Raymond International (UK). The scheme, scheduled for completion in June 1963, is mainly concerned with bituminizing the trunk roads from Nairobi to the provincial capitals, with the exception of Mombasa and Isiolo.

¶ A $3 million loan from the International Bank is being used to develop roads in areas of high agricultural potential. For the most part, they are secondary roads which link to main roads or railways.

¶ Six million dollars for general road improvement has been allotted under the 1960-63 government development program. However, this sum may be cut, along with the development plan as a whole, if Kenya's financial difficulties are not overcome.

Normal road building and surfacing skills, plus the construction of attendant earthworks, are required for this road program in Kenya. Bridges are few and small, and the terrain presents no special problems. For technical assistance, the Road Authority goes to the Ministry of Works, which employs a permanent engineering staff recruited through the Colonial Office in London. This staff handles the general running of the roads and minor improvement projects; for big programs such as those mentioned above, or where unusual problems are involved, the Chief Engineer, Roads, of the Ministry of Works (MOW) will call in and brief a consulting engineer. Occasionally he obtains specialist advice through the Crown Agents in London.

Van Neiker, Klein and Edwards, a South African consulting road engineering firm, with wide experience in African conditions, is employed by the Kenya government to supervise the $12 million contractor-financed road scheme. Other consultants are responsible for designing some of the earthworks.

Tanganyika and Uganda also rely mainly on MOW engineers for roads as for other public works — in Uganda it is rare for the government to call in consultants for any but the most specialized needs. Normally, the more limited the scope of any particular program and the funds available for it, the less likely is the consultant to be employed.

Other Transportation

Other types of transportation are being developed by East African governments as far as money allows. Tanganyika needs more railways; at present, the system consists of a central line, crossing the country from Dar-es-Salaam on the coast to Lake Victoria in the northwest and Lake Tanganyika in the west — branching at Tabora; and the Tanga-Moshi-Arusha line linking with Kenya in the northeast part of the country. There is also a short rail link in the southern province and another one, recently opened, which joins up to the central line the $10.5 million Kilombero Valley sugar scheme. A survey now being undertaken will lead to a link between the Central and Tanga lines. This project will cost about $7.5 million, and will, for the first time, give Dar-es-Salaam a rail connection with Nairobi.

Kenya is busy on its airports. The planned extension of Nairobi airport will cost about $750,000. The new Port Reitz (Mombasa) airport cost about $450,000, and at Malinde, a coastal resort, about $175,000 was spent on improving the airport. In all these places the British firm of Sir Alexander Gibb and Partners acted as consultants, through its branch in Kenya. Tanganyika has only one airport of international stand-

ing, at Dar-es-Salaam. Nevertheless, local airports, such as that already established at Tabora, will have an important part to play as the country develops.

Agricultural Development

Continued agricultural development is a major part of public policy in the East African territories, but, apart from transport links, this seldom involves any complicated engineering. However, exceptions to this are found in certain parts of Kenya, where the soil is good but water is scarce. Large scale irrigation is not suited to Kenya's land or water supply, but there are certain schemes for bringing water to potentially fertile areas. In 1956, the Hydraulics Department of the Ministry of Works called in Sir Alexander Gibb and Partners to examine a scheme to irrigate the Kano plains from Lake Victoria. It was found that the cost of irrigating about 55,000 acres would be nearly $9 million, the water being fed mainly by gravity with some pumping. Sugar would be the main crop, and the planned sugar factory would cost $7 million.

Another possible irrigation scheme in Kenya is the erection of a $9 million barrage on the Lower Tana near Garissa, watering at most 100,000 acres. Cotton would be well suited to this area. Against this scheme has to be set the isolation of the part of the country concerned, and the disproportionately high transport costs. In fact, water engineering is not likely to play a very large part in Kenya's economy in the near future. There is still much good land which is suitable for farming without irrigation.

Buildings

Comparatively large sums are spent by the authorities in East Africa on buildings of various kinds. The Kenya government spent over $9 million on building (including maintenance) last year. Less than 10 percent of this was in the hands of private architects – the rest was handled by the Ministry of Works' own structural engineers. Major building schemes in Tanganyika include a new University College, expected to cost about $4.5 million, and a new Parliament building in Dar-es-Salaam, likely to cost between $750,000 and $1 million. Architects are being asked to submit designs and plans. These two building projects are expected to be realized over the next three years, and the Parliament building will be followed by further replacements of old unserviceable government offices. Uganda, too, has its government building projects, among which two new hospitals take a leading place at present.

Private Works

Commercial and industrial buildings and one or two large scale power schemes are the main types of engineering activity in the private sector in East Africa. New schemes are limited at present to companies which already have a stake in the area – political uncertainty is discouraging new capital. One of the few exceptions is the recently announced BP-Shell plan to spend nearly $3 million a year on oil prospecting in Kenya under a new license.

Tanganyika, politically the most advanced and most stable of the three countries, has more industrial schemes afoot in the private sector, mostly on a fairly small scale. These include the sugar refineries for the Kilombero Sugar Scheme, cotton ginneries in Lake Province (built by the well established Victoria Federation of Co-operative Societies), and near Arusha, in Northern Province, a brewery and a boiled sweet factory. Encouraging evidence of foreign participation in investment is the $6 million tire factory being built for Michelin.

One of the few nongovernment enterprises in Uganda is the new Steel Corporation of East Africa, financed largely from private resources. The Corporation is to build a steel rolling mill at Jinjor for processing scrap metal. This undertaking has already been put in the hands of contractors as a package deal for design and construction. In Kenya, the East African Power and Lighting Company is closely associated with the British contractor, Balfour Beatty, and with the Power Securities Corporation. The company finances further development of electrical power itself – about $3 million was kept back last year for this purpose – but at present no big new lines are contemplated. The company does not intend in present difficult conditions to try to raise money in the market, but it seems that no major development of power in Kenya would be possible without outside help. The much-discussed Seven Forks Hydro-Electric scheme, for instance, may cost as much as $90 million. No arrangements for its construction have been made yet, but it is thought likely by outside observers that Balfour Beatty will get the contract and use its own consultants.

In Tanganyika, too, the largest single engineering scheme at present planned is a hydroelectric one – the so-called Hale Hydroelectric scheme on the Rangani River in Tanga Province. About $16.5 million is being made available for this undertaking.

The Use of Consulting Engineers

Although in the East African territories as a whole, consulting engineers are not in any great demand, in some places they are far more active than others. In Uganda, the smallest, poorest, and least developed of the territories, the consultant is a rare bird. Most schemes are government-run, and most engineering needs are government supplied. The exception, as pointed out, is the Uganda Development Corporation – but this body, too, makes little use of or has had little occasion to use consultants, having found

contractors' package deals convenient. The government uses contractor-finance, but never package deals.

The Tanganyika government has no objection to accepting a package deal from a contractor where this seems the best course — as in the case of the new water supply for Dar-es-Salaam, when the contractor himself employed a consultant. Nor, on the other hand, are the authorities unaware of the value of the services of consulting engineers; rather, they feel it an unnecessary extravagence to employ a consultant where the Public Works Department (which includes a Designs Department) can cope with the project. A correspondent in Tanganyika reports that the general attitude toward the consulting engineer is that he is "a desirable luxury, not an inescapable necessity." One consulting firm of UK origin is established in Dar-es-Salaam. Otherwise, when the government needs special engineering advice, it consults the Crown Agents in London, and the specialist advice provided is British.

In Kenya, the Crown Agents also act as go-betweens in this way, but the consultant is less of a rarity. Several UK and Commonwealth firms have offices in Nairobi, and there are a number of entirely local firms run by Europeans or Asians, often people who have previously been members of the government engineering corps. These often are engaged for quite small jobs, such as housing or roads for sisal and coffee estates. The present dearth of capital is leaving these smaller firms very short of work.

The government likes to use locally-based firms wherever possible, rather than call in consultants without first-hand knowledge of the country. The government engineers recognize the value of a consultant as arbitrator between the contractor and the Ministry of Works or even between the Ministry of Works and the Treasury. One Kenya firm, Howard Humphries, has a long-term contract with the Nairobi City Council and with the Kisumu Municipal Board to give advice on water problems. The work of Van Neiker, Klein and Edwards in connection with the roads, and of Sir Alexander Gibb and Partners in connection with airports and irrigation, has already been mentioned. This latter firm has what is regarded as the ideal set up — their representative in Kenya has a thorough knowledge of local conditions, but his reports are checked by the London office.

The Future

At present, therefore, though the consulting engineer is by no means unknown in East Africa, his employment is limited by the type and caliber of engineering skills required. When he does appear, he is almost invariably of local or London origin. How far can current events be expected to alter this situation?

Political implications apart, the trend in East Africa, or at any rate in Kenya and Tanganyika, is for the employment of more and more Africans in government departments, and this of course includes the government engineering corps. Africans are being trained as engineers, but it may well be that the process of "Africanization" for a while will outstrip the training of Africans. Thus, there may be something of a hiatus, during which outside specialists will be needed for tasks formerly dealt with by government engineers. Moreover, the more responsibility for government that is borne by Africans, the more ready may government departments become to consider employing non-British firms (though English-speaking ones still will be essential).

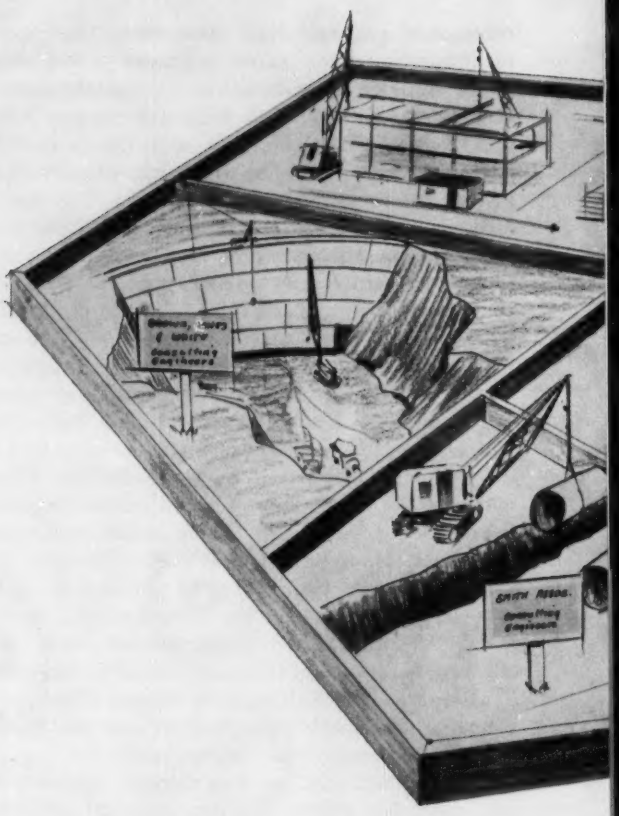
Apart from this possible gap-stopping, bigger opportunities for consulting engineers in East Africa still depend upon political events, which at present dominate the investment scene. But interest already is being shown from several directions, and can be expected to crystallize as soon as an atmosphere of greater certainty pervades the area. Kenya, for instance, has been visited recently by both private and government economic investigators from Germany; the latter took an optimistic view of the country's future and hinted that it might be a suitable target for some of the West German government's new program of aid to underdeveloped countries. Political independence, when it comes, can be expected to produce a government ready to consider capital loans from any willing country. In the nearer future it may be hoped that there will be a return to Kenya, from old or new sources, of the $45 million of capital withdrawn in the last 18 months.

Tanganyika — which in contrast only lost $15 million of capital in the same period — is already inspiring more confidence by the quietness and moderation of its political scene and its apparent success in establishing multi-racial government under an African premier. Investors merely seem to be waiting for the new regime to find its feet. Banking interests in Britain, the Netherlands, Switzerland, and West Germany, and commercial interests in the United States appear to be aware of the country's potential. Tanganyika may be able to realize its hopes of finding foreign sponsors for schemes to develop coal and iron deposits, as well as rubber growing and manufacturing of various kinds. The greater the investment, the faster the development; and the faster — and more varied — the development, the greater the need for consulting engineers. The future, particularly in Tanganyika, may bring considerable opportunities. The time to make contact is when development plans are initiated. Interested consultants can get in touch with the Director, Ministry of Communications, Power and Works, Tancot House, Dar-es-Salaam, or the Chamber of Commerce, Kelvin House, Arcadia Avenue, Dar-es-Salaam, Tanganyika. ▲▲

Geographical Location . . .

A Legitimate Qualification?

DONALD GOODKIND
Goodkind & O'Dea



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THERE CAN BE no argument that a fundamental key to success in consulting engineering is getting the job. The greatest knowledge, the maximum ingenuity, and the best intentions go for nothing if there is no project on which to apply them. And for the continued coexistence of body and soul, it generally is agreed that a reasonable fee, coupled to any noble engineering effort, is most helpful.

What qualifications should a firm possess and present to the client in order to get the job? What should a client look for in a consultant?

The basic requirements, which must be made evident to the client, are the ability of the consultant to perform the particular services which are sought and an availability to undertake the project at the required time. If the undertaking is of fair size, it normally follows that the consultant must have an adequate, trained staff and the facilities with which to accomplish the work.

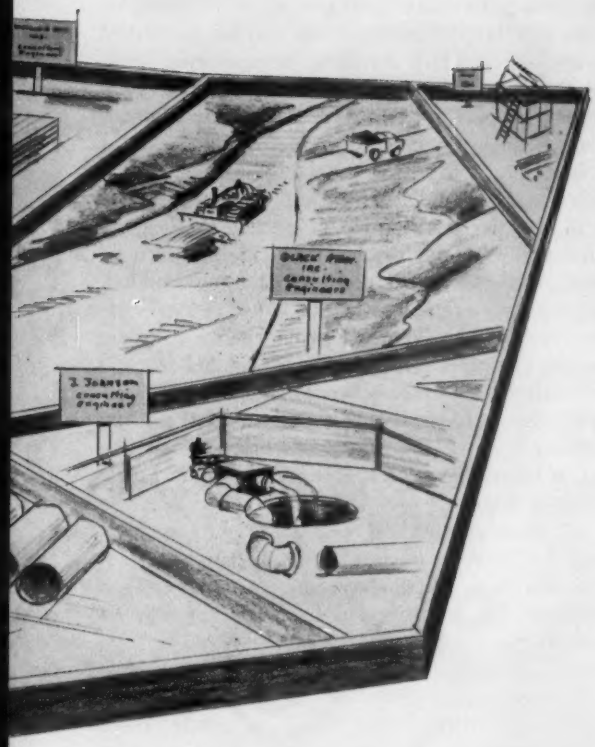
On consideration, however, these qualifications often are not so readily measured that a meaningful distinction can be made between one consultant and another. Within a given field of practice, there are normally a number of capable men whose difference in ability varies only slightly – a difference the prospective client could hardly be expected to appreciate. And it is a rare consultant indeed who, on being asked to submit a proposal for work, cannot wholeheartedly declare that he is available.

So, often an attempt is made to expand the qualifications to include more determinate items. For example, has the consultant ever performed similar work for the client, and is he familiar with the established procedures?

These criteria might severely limit the potential field and lead to the conclusion that the first consultant found fitting these requirements will be the only one. This situation does not give the client an opportunity to consider the varying services which other engineers might render. Moreover, if the work is large and varied, such as in the design of state highways, the initial list may not produce enough organizations even to undertake the work.

One supplementary qualification does offer a fairly clear-cut measuring stick on which to base a choice. Whether or not it has professional merit is a matter that is open for debate.

Does the consultant maintain a local office? For public work this question asks if the consultant's office is within the geographical boundaries of the political entity assigning the work. In private prac-



tice, it asks if an engineer's office is near the office or plant having jurisdiction over the project.

In their zeal to receive a reasonable share of assignments in their own back yard, consultants sometimes have sought through various means to advance and impose this type of closed shop qualification. In current practice a number of states limit assignments for public work, either by written directive or established policy, to firms located in the state. In one sense we all recognize that good engineering practice should acknowledge no such physical limitations. But as businessmen engaged in the never-ending struggle of meeting payrolls and paying bills, we cannot shrug off the inherent justice of receiving some special consideration for our proximity to the client.

Naturally, the question arises whether such a restrictive approach is in conflict with the best practice of engineering. We will consider several elements of advantage and disadvantage in retaining local consultants, to see if any judgment can be made.

Community Benefits

Undeniably, the local firm provides employment for local people who, in turn, pay the taxes that ultimately pay the fees in public work. The salaries paid to a staff are a definite contribution to the over-all business activity of a locality, particularly in the larger engineering firms. Moreover, the presence of prospering local engineering organizations brings to a community a number of specially trained and educated residents who are available to serve the public as members of semitechnical boards, commissions, and other groups. A community that has no employment opportunities for professionals certainly reduces its reservoir of trained citizens willing and able to help with civic problems.

The presence of qualified consultants within an area is furthermore likely to be an inducement to the influx of certain organizations which may have been waiting for the availability of professional services. The consulting engineer may serve as an effective nucleus about which a thriving industrial complex may grow in an area.

The desirability of having active and qualified consulting organizations within a physical area seems unquestioned. A practical way to insure their existence would be to see that the area provides the consultant with a reasonable share of the available work.

Local Factors

It is easier to consider the pros and cons of a closed shop in relation to particular assignments by public agencies, although the examples can be translated readily into other fields.

In choosing the location of a highway through a particular area, it is likely that a local firm will understand the local situation better than an outside firm. Often there are considerations beyond those revealed on a topographic map affecting the selection of the best route. What is apparent to a local organization may well escape the notice of an outside group, which can get the facts only after extensive inquiry and research into the matter.

On the other hand, the local organization may know too much about a subtle situation. Like a jury member who has read a columnist's pretrial judgment of the accused, the firm close to the local drama may be hard put to exercise independent judgment. The outside engineer, uninhibited by such insight, may be more able to appraise the pertinent factors fairly and render a true evaluation.

The local firm, of course, may be in an excellent position to adjudge the local sentiment for a large park and efficient marina. It may be expected to know how the affected citizens want their community to function. But it may be a difficult task for local engineers to distinguish between local desires and the demands of pressure groups. The approach to a foreign engineer, whose social well being is not so closely tied to his professional decisions, may be much more difficult for the influential local leaders.

It may be assumed that a local consultant will be more familiar with the workings of the present water

system. This background may serve him in planning the expansion of the mains and the addition to the treatment plant. But he may see a very small picture, severely restricted by his knowledge of the practices in the area. An outsider may be able to view the existing system in terms of experience with water systems in other areas and recognize its shortcomings. As a result, his new appraisal may produce not only an enlarged system but one that is a decided improvement over the old one.

Public Relations

Most public projects inevitably give birth to very vocal hard core opposition. Even when the benefits of a new construction are overwhelming, there are citizens who will view the situation with alarm. Since the technical considerations involved in establishing an improvement are difficult to relay to a nontechnical citizenry, public relations are strained. An obvious target of public indignation is "that bunch of foreign engineers."

A local engineering organization can be an instrument of good public relations without special effort. The engineers naturally will discuss the projects within their own social circle and in this manner disseminate information to a rather sizable audience. Certain of the engineers also will be available to discuss the work more formally with local civic groups. The outsider may not have the opportunity or desire for such intimate contacts.

Of course, in talking unguardedly to citizens, some very undesirable facts may be released or implied. This is a danger that might befall the outsider as well as the local engineer, but the latter's greater exposure would seem to make him a greater risk.

The local engineer who plans the municipal plaza and off street parking areas will have to live with the product of his efforts for a good many years. He never will find the sanctuary from its faults and shortcomings that an outsider will in an office hundreds of miles away. Conversely, the local engineer will be associated in the pubic mind for a long time with the satisfying facility he has produced. The outsider may forget the work until he rereads a few brief lines in his experience brochure to see if it is up to date.

The integrity of professional practice is a good guarantee that every engineer, local or foreign, will give his best effort to each assignment. However, the satisfactions of true accomplishment are more likely to accrue to an engineer who in some sense remains attached to the product of his creation.

Danger of Provincialism

The outsider can better balance local and outside experience in judging the needs of the project. When a particular phase of work, such as determination of right of way, might benefit from intimate knowledge, he can arrange to obtain local specialists; the complex analysis of a large concrete dome can be performed in his own office, which may have an experience backlog in the design of such domes. Of course, the local engineer also may go outside to engage special talent, but often this may be interpreted as a measure of local incompetence. In placing a portion of his work outside the area, the local man also may be negating some of the very benefits that influenced the original assignment. To a degree, his freedom of action in obtaining assistance and consultation seem limited.

Keeping local engineering in the hands of local consultants may create a type of provincialism fostering an actual resistance to new ideas. A single method of preparing specifications may gain dubious authority because it always is done that way. When the probability of exercising any outside judgment is eliminated, it becomes easy and natural to adhere to the old way of doing things. When a certainty develops that all local engineering eventually will be performed by local engineers, the engineering group may be able to exert influence on what engineering is to be done. The projects and their concept may be limited to the ability of a restricted group. In such a situation, progress of any kind is ill served.

Even when a state agency determines to retain only firms practicing engineering within the state, there arises the question of how this regulation is to be met. If a consultant with headquarters in another state establishes a new office in the state for the performance of an assignment, does he become a local firm? This seems to evade a good many of the purposes for which the restrictive regulation has been created. However, it might be impossible, if not illegal, to place more definite limitations on what constitutes an organization practicing within a given state.

It can be seen from a brief survey that the results of limiting practice in any area to local firms are not all beneficial. Yet, in many instances, rather distinct advantages do exist. It would be gravely remiss to fail to consider the ethics of establishing a local qualification for professional practice, for, basically, good engineering is founded on ability and integrity.

Professionalism vs Economics?

The consulting engineer lives and works in the two worlds of lofty professionalism and hard boiled economics. It does not follow that these two worlds must be in conflict. The primary objective is to satisfy the demands of both without violating the standards of either ethics or economics.

A locality qualification presents the type of situation which endangers this balance. However, where the ability and availability are given foremost consideration in making engineering assignments, it does not appear improper to give some weight to the location of the engineering practice. ▲▲

Engineers Must Understand Acoustics

JEROME GOODMAN
Consulting Engineer

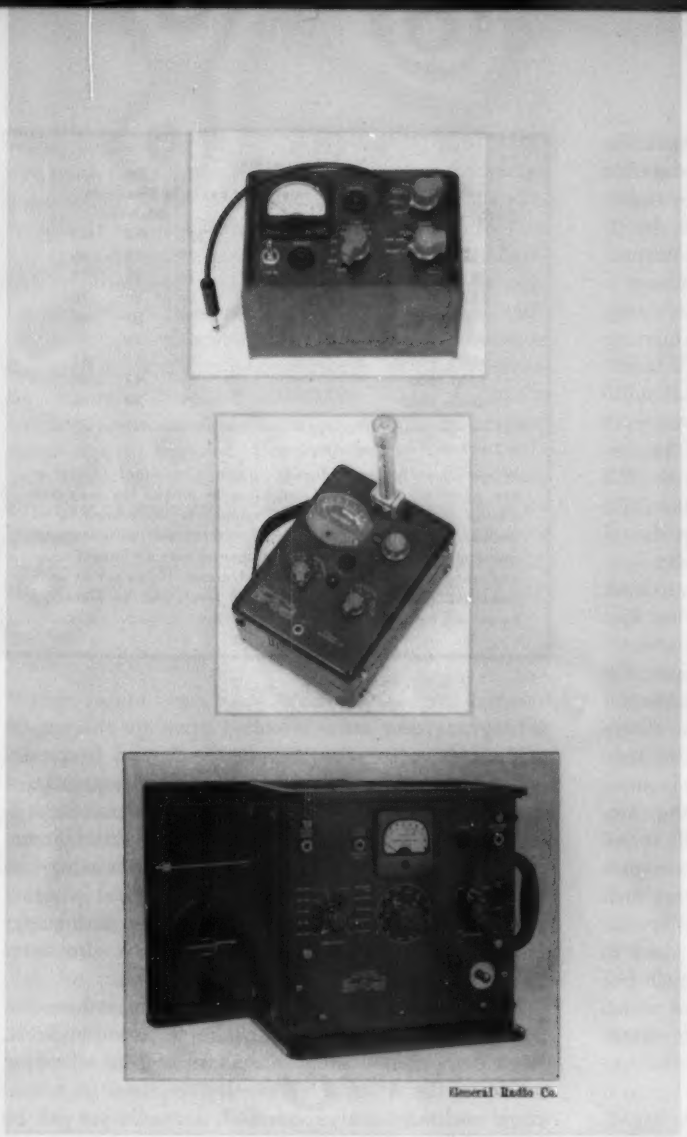


Fig. 1 – Three basic instruments are used to measure sound. Top to bottom: impact noise analyzer; sound level meter; and octave band analyzer.

IN THE DRIVE to extract the maximum useful energy from machines and processes, American technology often has neglected acoustic design. As a result, both preventive and punitive legislation have been passed in many cities and states – zoning regulations are written to limit noise, and Workmen's Compensation statutes are enacted to counter its effects. This has obliged the consulting engineer to make a more careful study of noise. He must be able to design structures to comply with existing laws, and to testify in cases where noise causes discomfort or injury.

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Damage to Hearing

It is known that exposure to intense noise over a period of time will result in a hearing loss. Continued immersion in an intense noise field will result in deterioration of the neural activity of the inner ear. This physiological degeneration is detected as an impaired hearing ability, and in recognition of this, various states have set up schedules of awards for industrial hearing loss. New York State, for example, currently allows $7500 for a 100 percent loss of hearing in its Workmens' Compensation Schedule. Estimates reveal that the average claim will be $2000, since few structures, machines, and processes have been specifically designed to protect workers from noise. Statistically, if only 10 percent of the six million eligible workers in New York State are successful in prosecuting auditory damage claims, $1.2 billion is payable to them.

When medical data is insufficient to decide a compensable hearing loss case, an acoustical engineering

survey can determine if a work area is acoustically hazardous. The consulting engineer prepares data for presentation to Compensation Boards and insurance companies. Since over-all sound pressure level by itself cannot fully describe the nature of a noise, a spectrum analysis of the questionable noise is required.

A sound level meter and an octave band analyzer, conforming to specifications set up by the American Standards Association, are used to gather acoustic data. The sound level meter measures over-all noise in decibels of pressure, and the octave band analyzer connected to the sound level meter indicates the distribution of energy in eight bands, ranging from 37.5 to 9600 cycles per second. When readings on the eight octave bands are added logarithmically, they should equal the over-all level measured by the meter.

The sound level meter and octave band analyzer suffice for the measurement of continuous noises that do not exceed certain levels. However, certain acoustic situations will require more elaborate equipment. For example, levels above 130 decibels often are measured with a condenser microphone attached to the sound level meter. Frequently, high noise levels are tape recorded and analyzed later in the laboratory, since extended exposure to intense noise can damage electronic equipment and injure personnel. Skill is required in the use of acoustic instruments, to interpret the data and to account for errors due to factors such as diffraction and reflection. Fig. 1 shows several common acoustic instruments which can be used to gather data that are acceptable as legal evidence. For the measurement of short lived noise impulses which are not readable with the sound level meter, certain noise codes require the use of an impact noise analyzer attached to the sound level meter.

The U. S. Air Force Damage Risk Criterion, Fig. 2, is expressed in octave bands. It is estimated that if the levels in each of the continuous noise octave bands are exceeded continually for an eight-hour day, five days a week, in a 25-year working lifetime, it is likely that an unprotected ear will experience decreased hearing acuity.

Another criterion, published by the American Academy of Ophthalmology and Otolaryngology, requires less field information than that of the Air Force. Should the noise level reading in either the 300-600 cycle band or the 600-1200 cycle band be 85 decibels or more, the nature of the noise is potentially dangerous to hearing. It must be remembered that these criteria do not apply to short exposures, or to impact noises and narrow band noises.

Insufficient data exist to set up an absolute criterion for hearing damage. Despite widely varying individual susceptibilities, otologists feel that if the two criteria noted above generally prevail, people ultimately will experience a hearing loss. In legal proceedings concerning claimed hearing loss, the consulting engineer often is called upon to give expert testimony pertinent to the magnitude and frequency distribution of an offending noise. Subsequently, a qualified otologist usually renders his opinion regarding the noise hazard and its damaging qualities. Sometimes the engineer must prove that the hearing loss test was conducted in a suitable acoustical environment. In addition, a certification of the audiometer (hearing evaluation device) calibration is sometimes offered in testimony.

TABLE I

Maximum Sound Pressure Levels in Decibels

Octave band (cps)	*District*		
	M1	M2	M3
20-75	79	79	80
75-150	74	75	75
150-300	66	68	70
300-600	59	62	64
600-1200	53	56	58
1200-2400	47	51	53
2400-4800	41	47	49
above 4800	39	44	46

M1 — light manufacturing; M2 — medium manufacturing; M3 — heavy manufacturing.

When a manufacturing district adjoins a residence district at any point on the district boundary or within the residence district, the maximum permitted sound level is reduced by six decibels in all octave bands. An intermittent or infrequent sound must have its peak value measured with an impact noise analyzer attached to a sound level meter. If impact noise is measured, the maximum octave band levels may be increased by six decibels.

Several methods can be employed to reduce the noise of an existing structure to a tolerable level. After determining the noise spectrum of an offending machine, the acoustic properties required of a machine enclosure can be specified. An enclosure can be built with prefabricated panels, if suitable, or with walls of high density material. Provision should be made for lighting and ventilation.

There have been instances where the need for a noise attenuating enclosure has resulted in a consid-

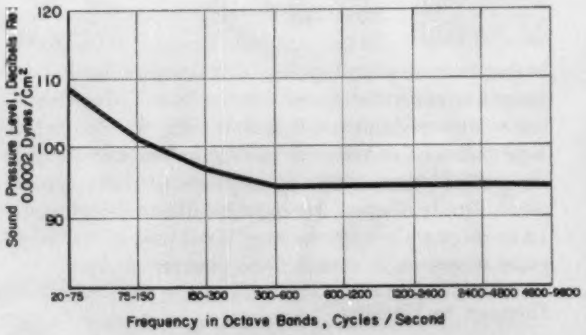


Fig. 2 — Danger levels in different octave bands, as given by the United States Air Force Damage Risk Criterion.

erable engineering project. However, the most effective noise control can result from an alteration of the noise source – for example, the substitution of nylon or fiber for metal gears can reduce the noise produced by some mechanisms. Where the noise abatement treatment of certain machines and processes may be too complicated or expensive, the logical cure might be process automation which would eliminate the need for workers in acoustically hazardous areas. An economic study for automation would weigh the frequency and amount of auditory compensation payments against the cost of automation.

In those instances where the cost of acoustic construction exceeds any potential saving, the most practical means of reducing noise exposure is the issuance of individual ear protection. However, an individual ear protector does not afford the same continuous protection as proper acoustic construction.

Zoning Regulations

Within recent years many communities have imposed limitations upon the acoustic noise generated within the area bounding manufacturing operations. The zoning statutes of New York City and Chicago define specific acoustic spectra limits at the lot line of a manufacturing plant. The consulting engineer often is retained to determine if an acoustic nuisance exists before a manufacturer's neighbors institute legal action for abatement of such a nuisance. In addition to preventive and corrective applications, acoustic data can be used to quash nuisance proceedings when noise levels do not exceed the statutory maximums.

The New York City Zoning Resolution goes into effect on December 15, 1961. The performance standards of the resolution specify that the noise level on or beyond a lot line shall not exceed the values in any of the octave bands as shown in Table 1.

The American Standards Association has not yet set up a specification for the measurement of impact noise. Also, it is not clear whether the measured peak level of an octave band has any real significance by itself, since the peak is not one that occurs in a physical sound wave.

As an example, a computation indicates that the maximum octave band levels for an M3 area total approximately 82 decibels over-all. If adjacent to a residential district, the level becomes 76 decibels. In New York City and other metropolitan centers, where residential areas adjoin manufacturing districts, the costs run high for acoustic correction of existing structures. Acoustical considerations tend to raise the cost of new construction since no more than 76 decibels will be legally emittable from industrial structures. Incidentally, 76 decibels represents a comparatively low noise level for a busy section of a big city.

The specific noise reduction measures depend upon the elements of an individual situation. General engineering conjecture envisions need for new windowless industrial buildings to meet acoustic codes. Mufflers will be used at gas intake and exhaust points. Delivery platforms will be recessed and covered. Interestingly, acoustical silencing measures for the air conditioning system of the windowless structure also will be required in most instances.

The Forensic Acoustical Approach

When a new industrial building is contemplated, the site survey should include a study of the existing acoustical noise from traffic and surrounding areas. One then can determine how much noise may be added to the area. In the case of particular metal working and textile operations, the added cost of acoustic construction might prove uneconomical and necessitate a change in prospective plant location.

An existing body of empirical data permits a rough prediction of community reaction to various acoustic stimuli. These data show that noise levels not exceeding those of various zoning codes sometimes cause individuals to suffer an acoustic nuisance. There are instances where a manufacturer complies with a local zoning ordinance, but neighboring residents still may institute legal action to abate the noise. In such case, noise abatement is more a matter of good neighborliness than adherence to a zoning code.

The residents of areas surrounding the landing fields of aircraft manufacturers are prone to start legal proceeding in an effort to limit flying activities during the evening. In many instances these suits have been set aside because the operation of the airfield was held to be vital to the national defense. The specialized acoustical problems of airfields are difficult to solve. For example, ground run-up mufflers can attenuate the noise of a jet engine, but when the aircraft leaves the muffler, the noise becomes very objectionable.

The inclusion of acoustic limits in zoning codes greatly simplifies the specification of acoustic construction techniques – also the legal defense in a noise abatement proceeding. Two events that occurred previous to the publication of the current New York City Zoning Resolution serve to illustrate this statement quite clearly.

The writer was asked to appear as an expert witness in behalf of a firm that had installed the mechanical elements of an air conditioning system on the roof of a supermarket. A tenant in an adjoining apartment house had instituted legal action to have the noise abated. The firm was told that if the equipment noise was measured and acoustic data presented before a court of law, it would be necessary to prove that a commonly accepted criterion for annoyance was not exceeded. At the time, several arbitrary criteria existed; however, they had no legal standing and therefore were indefensible. Subsequently, an enclosure for the equipment was designed. If the zoning require-

Fig. 3 — The size and complexity of industrial mufflers mean they often must be specially designed and fabricated.

ment could have been used as the basis for acoustical and structural calculations, the cost of this enclosure would have been lower.

In another instance, the New York City Zoning Resolution, during its formative stages, had designated the area next to a large metal working plant as a residential neighborhood. The owner of this plant had two questions:

¶ Did his present operation comply with the standards of the zoning resolution?

¶ Contemplating expansion, how should he build a structure on an adjacent lot to duplicate his existing plant and still comply with the zoning resolution?

Neither of these questions could have been answered until the zoning resolution was enacted. Statutes designate a period during which the existing building must be altered to conform with the noise code. There also was the possibility that acoustic data would convince the Board of Standards and Appeals to allow a variance, since noise from adjacent trucking and rail facilities exceeded that of the metal working plant. Even if the noise of the operating metal working plant proved equal to that of the background level, the neighborhood noise would be increased by only three decibels. Here is a common situation where the presentation of adequate acoustical data to judicial and to semijudicial bodies can affect major engineering effort and the cost of alteration or construction.

For purposes of engineering planning and for legal action, it is necessary to obtain much more than rudimentary over-all and octave band level data to determine the character and treatment of a noise. Frequently, to assess a situation adequately, one must know duration of noise, repetitiousness, when the noise commonly exists, the distance from traffic and other transient sources, and the proximity of residences. Acoustical data are available for the noise produced by various types of machinery. These data, combined with a knowledge of the proposed internal sound absorbing characteristics of a structure, allow the engineer to estimate the probable noise at various points within the structure and the noise radiated to the surrounding community. This information, combined with the over-all community data, provides the case for a zoning variance that can then be determined and prosecuted.

What the Consultant Should Know

To be able to advise his client properly, the consultant must understand these facts:

¶ There are legal curbs on the production of noise that is dangerous or irritating.

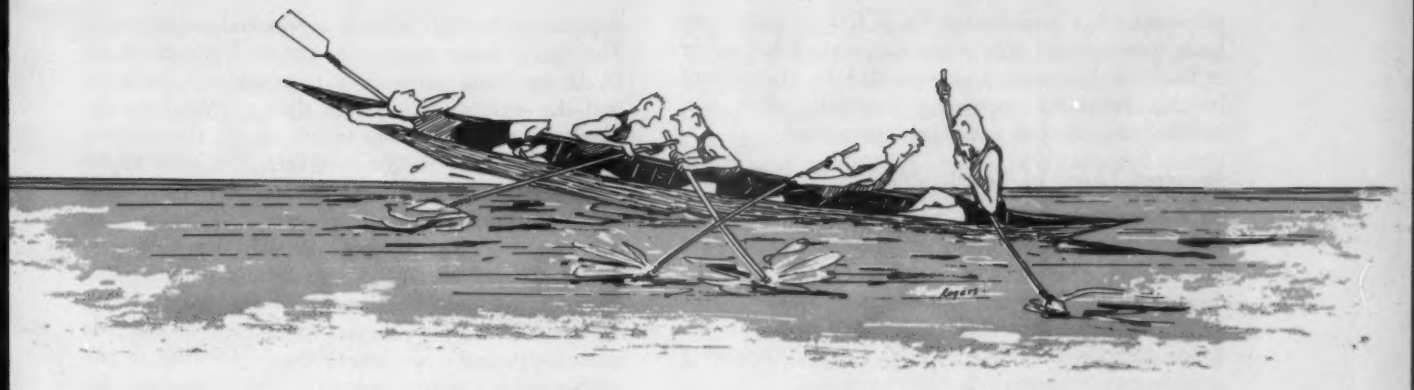
¶ Rudimentary acoustic data for structural planning and for legal purposes are acquired with the minimum instrumentation of a sound level meter and an octave band analyzer.

¶ Maximum noise levels and spectra are specified in pertinent Compensation statutes and zoning codes.

The consulting engineer should know these things to prepare building plans that meet the needs of the client and of the surrounding community, and to defend the plans before those authorities concerned with the enforcement of noise legislation.

Attention to the acoustic factors of construction is vital to the consulting engineer with an eye on future business. The increasing emphasis on noise abatement has created substantial projects that have an acoustical basis. While the acoustical engineering is a small part of most projects, the associated structural and mechanical engineering can be rather sizable. Fig. 3 indicates the magnitude of a muffler to be installed at a power plant. This device, designed to attenuate exhaust noise, required major structural and mechanical design effort to produce efficient acoustic operation. Few mufflers are off-the-shelf items, since they usually are designed and built for specific applications.

New York has been a leader in the creation of legislation that is often adopted by other jurisdictions. However, since the noise standards of New York City and New York State differ slightly from other areas, the consulting engineer must be sure that his design criteria will meet local conditions. As people become more noise conscious, it can be expected that local standards will become more severe. The increasing emphasis upon acoustics as a factor in modern construction and planning will require the consulting engineer to devote a major effort to noise analysis in order to meet the future needs of his clients. ▲▲



Efficiency Requires Coordination

ROBERT W. RICHARDS

Howard, Needles, Tammen & Bergendoff

CE exclusive

LOW FEES, inadequate payment for extra work, and costly delays may be just cause for complaint, but the consultant who wants to remain in business must do more than complain; he must apply his skill to the resolution of these management problems, just as he does to the engineering problems of his clients. Technical competence is no longer the only criterion for a qualified engineer. Good engineering increasingly calls for emphasis on economy. As Arthur M. Wellington stated many years ago, in *The Economic Theory of the Location of Railways,* "Engineering is the art of doing that well with one dollar, which any bungler can do with two after a fashion." Wellington undoubtedly was thinking of engineering as applied to the problems of his client, but his classic statement is just as applicable to the internal problems of a consulting firm.

In a nutshell, how can a consultant profitably perform quality engineering services for his clients despite low fees, change orders, and delays? The solution lies in coordination of man power – best effected by a coordinator.

The Coordinator's Function

Exactly what is a coordinator, or what does a coordinator do? By "daffynition" he is "the guy who sits between two expeditors." Seriously, we may think of a coordinator as one who promotes harmonious action between individuals or groups toward a common goal for the benefit of all.

From the preceding statement it is evident that a coordinator must work with people. He must work with those people who are direct producers to make sure that they are working to advance the best interests of the firm rather than the selfish interests of an individual or group. Quite obviously, there is no need for a coordinator in a one-room office where one supervisor directs the efforts of everyone. There is still a need for coordination, but the one supervisor must meet this need along with his other responsibilities. When the size of a firm exceeds the one-room office and the single supervisor, then the need for a coordinator develops. At first, the services of a full-time coordinator may not be required. There is a limbo between no coordinator and a full-time coordinator which must be met by a versatile person who can spend a part of his time directing others and the rest of it producing directly himself.

From the cold standpoint of cost, a coordinator is overhead. Overhead is the ugly head in business today. It is to be avoided or minimized wherever possible. Yet, no one will argue that certain items of overhead are essential. It would be shortsighted economy to eliminate insurance protection, cost accounting, and the servicing of equipment. Such items call for a modest expenditure today as a means of avoiding a much larger expense tomorrow. The em-

ployment of a coordinator on a full or part time basis is warranted only when the cost of his salary is likely to be equaled or exceeded by the savings he can effect in decreasing duplicate effort and utilizing the time of unassigned personnel.

Required Levels of Coordination

In a consulting firm with more than a single office, at least three distinct types or levels of coordination are needed. They include:

¶ Coordination between offices — usually assignable to a partner, corporate officer, or staff executive

¶ Coordination between projects — usually requiring a work coordinator or office engineer

¶ Coordination within a project — usually handled by a project engineer or manager

At each of these levels, coordination is equally essential. Among the advantages to be gained by coordination are:

¶ Consistency of policy

¶ Uniformity of operations

¶ Speed of production

¶ Efficiency of man power

¶ Satisfaction of personnel

¶ Elimination of duplicate effort

All of these advantages combine to effect economy and to enhance quality, which in turn will improve the competitive position of any firm. It follows that a reasonable margin of profit hinges on the relative competitive position. Hence, the very life of a firm may depend on the success of its coordination.

Between offices of a large consulting firm, there must be coordination, often involving basic company policies. For this reason, it must be carried out by partners or ranking corporate officers. Typical matters requiring top level coordination are:

¶ The kind of work to be sought and undertaken

¶ Clients to be solicited and by whom

¶ Fees to be charged, within ethical limits

¶ Promotional material, published and distributed

¶ Personnel policies, salaries, and fringe benefits

¶ Payroll, accounting, bookkeeping, and tax returns

¶ Insurance, such as general liability, auto liability and physical damage, professional liability, and fire

¶ The exchange or promotion of key personnel

¶ The interchange of technical data

¶ The utilization of major capital equipment items

Within a particular project, the project engineer or project manager is responsible for coordinating the various operations which must be performed. On a highway project, for example, surveys, subsurface explorations, utility negotiations, and right-of-way determinations are only a few of the necessary prerequisites which the head of a project must coordinate with design and the preparation of plans.

The third type of coordination, coordination between projects within the same office, is of equal importance, but too often is overlooked or neglected. The reason is not surprising — there is no one to do it! At top level, partners or corporate officers know that the economic health of their organization depends on policy decisions which have a coordinating effect. They may designate a subordinate to implement and report on these decisions, but they know that operations within their several offices will be consistent with their desires. Similarly, a project engineer or project manager knows from experience that he must not only be responsible for the technical aspects of his job, but also the organizational and economic aspects. He knows the importance of adhering to a progress schedule and a budget. He knows, too, that a job poorly organized or personnel inefficiently utilized will tend to put the job behind schedule and over the budget. There is usually adequate coordination within a project when a competent project engineer is in charge.

Coordination between projects within the same office must be carried out by a staff engineer who has the qualifications of an efficiency expert, a psychologist, and a diplomat. His title may be chief engineer, office engineer, or work coordinator, but that is unimportant. What really matters is that he has the recognized authority to make decisions; a sense of responsibility for the best interests of the company; and the respect of those who must abide by his decisions. Let us call him a work coordinator.

Unless the work coordinator is vested with authority by the partners or corporate officers of his firm, he becomes a figurehead whose popular decisions will be recognized and whose unpopular ones will be ignored. In safeguarding the best interests of the firm he is obliged on occasion to inconvenience a few for the over-all or eventual good of all. Such action is not easy. Project engineers will plead persuasively and plaintively for decisions to expedite their individual projects, but the work coordinator must not succumb to the "wheel which squeaks loudest." Nor can he afford to avoid decisions or postpone action, hoping to avoid unpopularity.

Of equal importance to authority and responsibility is respect. Without the respect of his associates, a work coordinator cannot do an effective job. Respect cannot be delegated or bought; it must be earned. It can be earned best by a man who has a sound knowledge of engineering and a reputation for being fair. Consequently, the work coordinator preferably should be a graduate engineer with diverse experience, mature judgment, and unswerving integrity. He also must have a sincere interest in people as well as genuine concern for the prosperity of his firm. Men with these qualities are not in plentiful supply. They are scarcer than the whip-cracking, bulldozing chief draftsman of yesteryear, because an understanding of people is more difficult to ac-

quire than a crude vocabulary. The company fortunate enough to have a qualified work coordinator should value him; the company without one would do well to find one at once.

Importance of the Work Coordinator

Why is a work coordinator so important and what does he do to justify his position? His principal duties would include the following:

¶ Selection of key personnel – At the beginning of a new project, the partner or corporate officer in charge must delegate primary responsibility for completing the project to a project engineer or project manager. The selection of such supervisory personnel should be based on the nature of the project and the qualifications of available experienced engineers.

Being better acquainted with personnel in the office than any one else, the work coordinator can be of invaluable assistance to top management in suggesting qualified candidates to direct a new project. He knows that a project engineer must earn the confidence of his superiors, the loyalty of his subordinates, and the good will of his client. This threefold requirement disqualifies many engineers despite their excellence in technical work.

A capable work coordinator understands the natural differences in human motivation. He can encourage and promote the budding supervisor and, at the same time, he can use his influence to keep those without supervisory talent or ambition in positions where they can make their greatest contribution to the firm. A man finds his greatest personal happiness when engaged in work he can do well.

¶ Assignment of personnel – When a project engineer needs more men, he should merely advise the work coordinator how many in each classification the job requires. Through his knowledge of personnel in the office, his familiarity with the project needing men, and the relative priorities of all jobs in the office, the work coordinator can decide whether personnel should be transferred from less pressing work or whether additional help must be employed.

Quite obviously, it is desirable to have every man working at his highest skill, but the work load in an office at any one time may call for a preponderance of one particular skill. Consequently, the work coordinator must continually strive to keep his pool of manpower versatile. Unlike a trade union, where a bricklayer cannot do carpentry, a structural designer may be called upon to do highway alignment, a drainage specialist may be asked to check plans, or a photogrammetrist may be needed for quantity takeoff and estimating.

The alert work coordinator maintains a file of talents so that requests for man power can be readily met. Parenthetically, it might be mentioned that a work coordinator must be sensitive to personality clashes. Certain people have difficulty getting along with others. Wherever possible, personnel assignments which might create friction between people, and thereby impede the progress of work, should be avoided. At all times, the work coordinator should maintain a master personnel distribution list showing the assignment of every man in the office.

¶ Secondary assignments – Every work coordinator will be confronted at times with the problem of finding work for personnel available for assignment. This problem usually arises when a major project is held up for client approval or for decisions on future alternates. Whenever possible, released man power should be transferred to other productive jobs to avoid general time charges, but other jobs may not absorb all of the available personnel.

Obviously, surplus personnel can be terminated, but such a drastic course of action is unwise if temporarily unoccupied personnel will be needed when approvals or decisions will permit resumption of the work. Nor is it wise to have people unoccupied for any length of time, for they will lose their zest and capacity for work. In addition, they will talk with those who are busy as well as with those who are idle, with the result that inefficiency and lethargy will replace industry and concentration.

A competent work coordinator will do his utmost to keep all personnel occupied at all times. If they cannot be assigned to productive work, they should be given other assignments which will be indirectly or eventually beneficial to both employer and employee. Such work may be called secondary assignments. Typical secondary assignments include: filing and indexing of calculations; preparation of completed studies, plans, and reference drawings for microfilming or storage; work on brochures and other promotional material; writing articles for technical magazines or company publications; formulation of design standards and charts; additions or revisions to the drafting room manual and other manuals; studies and plans for revising the arrangement of offices; layouts for new standard forms; advance work on scheduled reports for clients; and reporting on research involving new materials or methods.

¶ Appointment of specialists – In every office there should be a staff of specialists who have concentrated on particular subjects within their branch of engineering or closely allied to it. No partner or project engineer can be expected to keep up to date on all the many facets of his chosen profession. It is preferable to have a qualified group of associates within the firm who can be consulted when problems arise involving their specialized knowledge. The work coordinator must appoint engineers who are interested in adding to their knowledge and who are willing to become well informed on some particular

subject. It should be understood that those selected to become specialists will not neglect or abandon their previous skills. They will merely add to them.

Initially, it will be necessary for an expert to put in time outside normal working hours without expectation of overtime pay. Thereafter, time could be spent during office hours whenever there is a lag in the demand for productive work. In every engineering office there should be specialists on unit prices to be used for estimating; methods and materials for reproducing engineering drawings; microfilming; cataloging of books and pamphlets for the office library; storage of inactive correspondence and drawings; filing of vendors' catalogs; graphic arts, including type design and layout of illustrations for printing; and cameras and projection equipment.

Besides these general subjects, pertinent to any office, there are many other subjects which would be of value, depending on the particular branch of engineering in which a firm may specialize. If a consultant were engaged in highway work, for example, there should be specialists in design of rigid and flexible pavements; portland cement concrete and the use of admixtures; bituminous materials; selection and gradation of aggregates; traffic signs; guard rail and delineators; pavement marking materials; toll collection equipment, including automatic devices; epoxy resins and their applications; interpretations of aerial photos; and paints and protective coatings.

¶ Performance evaluation — At least twice each year, the work coordinator should have a quantitative appraisal made of each engineer and draftsman in the office. Such an appraisal can best be made by furnishing project engineers with a rating form for each person under their supervision, along with appropriate instructions. The instructions should be sufficiently explicit to minimize variations in rating between supervisors. It is also advisable to have each person rated by two supervisors, possibly the project engineer and one of his group leaders, to minimize personal prejudices. The content of a rating form is a matter of individual preference, although it is good practice to provide space for comments by the raters.

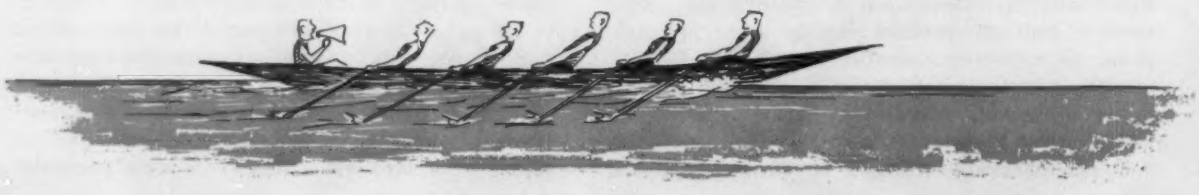
Semiannual performance appraisals serve many purposes. In addition to disclosing those who merit salary increases, they also tell whether a person is performing his current assignment satisfactorily and getting along with his supervisors and associates. They also indicate when a man should be considered for more difficult work, be assigned a different type of work, or be considered for termination.

¶ Monthly reports — In his unique position, the work coordinator is eminently qualified to issue regular reports to top management on the operations of the office. It is up to him to obtain, from each project engineer, the necessary information so that each month he can issue manpower requirements for the next six months. This report will disclose the probability of surplus personnel or of insufficient personnel. It also will show required completion dates for all projects in the office.

A progress report is also useful for showing expended hours and budgeted hours for every active job, as well as the actual percentage completion versus the percentage of budgeted hours expended. This report is a barometer of cost control. It shows at a glance which jobs are progressing satisfactorily and which ones are falling behind schedule. In the latter event, it is up to the particular project engineer to explain the factors which have caused his job to exceed the budget. There are many different formats which these reports might take, but this is not nearly so important as their regular release at specified intervals. The work coordinator must inform top management on current conditions in time for them to take prompt action rather than advise them of past conditions. His reports also must be brief so that they can be digested quickly.

Coordinators Can Save Money

Along with bureaucrats and boondoglers, coordinators are likely to be associated with depression days, wartime inefficiency, or governmental mismanagement. While it is true that New Deal attempts to move the nation's economy from its dead-center position in the '30s called for countless coordinators to effect price and production controls, the coordinators were appointed to office because of a compelling need for their services. Similarly, during World War II, when the nation had turned its production potential from peacetime purposes to an all-out military effort, coordinators were needed in Washington to schedule the many forces of production so that their combined effort would be cumulative rather than subtractive. Unlike bureaucrats and boondoglers, coordinators in a consulting office can save money for the firm. ▲▲



Engine and car on the Mount Washington Cog Railway.

Cable and Cog

RICHARD SANDERS ALLEN

IN THE 1820s the United States suddenly became aware of canals — and went quickly from awareness to intoxication. New York State's enormously successful Erie Canal had shown the way, and other regions envied the rich trade and glowing commercial prospects offered by artificial waterways. From Maine to Florida, promoters scanned maps, juggled estimates, and lured investors.

Northern New Jersey looked particularly good to the canal planners. Along one side stretched Pennsylvania's Lehigh Valley, with an abundant supply of newly-accepted anthracite coal. At the other edge stood a growing world port — New York City. In the middle were iron ore deposits, with adjacent furnaces crying for coal because their charcoal reserves were nearly exhausted. Here was an ideal situation for a canal, to carry coal to the furnaces and carry the iron to New York.

But there was a drawback. To traverse the country from the Delaware River to sea level at Jersey City, any artificial waterway would have to overcome a 2134-ft vertical rise and fall in the space of a little over a hundred miles. The regular stone canal locks, or even makeshift wooden ones, were out of the question, for two or three hundred of them would be necessary. Meanwhile, the Morris Canal had been chartered, to cross northern New Jersey, but no one knew quite how to build it.

The solution came from a quiet Englishman who taught Natural Philosophy at Columbia, professor James Renwick. His plan made the canal an engineering wonder, called "the boldest canal in existence." Renwick included some conventional wooden-gate stone locks in his plan, but featured inclined planes. He designed a series of marine railways capable of raising or lowering boats considerable distances from one section of the canal to another. Twenty-three of these inclined railways were built. On grades of a little better than 10 percent, each plane stretched from 500 up to a distance of 1500 feet, with an average lift of 63 feet. At places like Newark, Boonton, and Waterloo, a boat was nosed into a large skeleton crib on flanged wheels, attached to a long rope cable.

Tumbling through a perpendicular drop and flume, the water of the canal itself turned a 24-ft Scotch turbine geared to a hoisting rope. Out of the basin below came the boat in its cradle, to go creaking up the incline. At the head of the plane it again became waterborne. Reversing the procedure, a boat had only to be snaked up over the hump which held back the water of the upper level, and the forces of gravity, checked by a chained sprocket wheel, let the craft down to resume its journey behind the

The Mahanoy Plane, near Frackville, Pa. The Mahanoy & Broad Mt. RR used this 2600-ft coal carrier from 1862 to 1932.

flop-eared mules on the towpath. Just one man was needed to operate each plane, and an up or down movement seldom took longer than 10 minutes. Professor Renwick's inclined plane Morris Canal attracted professional attention and admiration, and carried 70-ton boats for nearly a century.

Pennsylvania Canal System

Despite their proven practicality and efficiency, the inclined planes were not readily adopted by other canals. Only one other artificial waterway made use of the principle — and that only after modification. This was the state canal system of Pennsylvania, where engineers somehow had to find a way to transport loaded boats up and over the Allegheny backbone between the water termini at Hollidaysburg and Johnstown. After much study, numerous surveys, and prolonged controversy, it was decided to build the 39-mile link as a portage railroad, consisting of 10 inclined planes with level horse-drawn railroads connecting them. The summit of the line was 2326 feet above tidewater, doubtless the greatest height ever reached by a fully loaded canal boat.

The Allegheny Portage Railroad was built in 1831-34 by the Commonwealth of Pennsylvania, with Sylvester Welch as principal engineer. The hoisting machinery could not be operated by water power as it was on the Morris Canal. Instead, two-cylinder, 35 hp, stationary steam engines were geared to the hemp lines which pulled the cars and boat-cribs up at a steady pace. Hemp for the ropes was imported from Italy and Russia, and the malleable iron rails came from Welsh foundries.

The operation of this pioneer mountain railway became smoother after the introduction of locomotives on the levels between planes. Passengers traveled in regular railroad carriages, and boats went up and over bodily in their specially-designed cradles. There was even an "articulated packet-boat" service, with

The enclosed Mt. Holyoke Cable Railway. Visitors rode in the car or climbed the 522 steps — either way it cost 75¢.

vessels built in two sections — hinged in the middle — to fit on the Portage Railroad's facilities.

This unique transportation system continued in existence for 20 years. Its biggest headache was always the rope, which caused continual trouble, anxiety, and expense. The hefty hawsers, spliced to make them endless, were seven inches in diameter, and, in some cases, over a mile long. Their average cost was $3000, and even with tar preservative and the best weather conditions, a hemp cable's average lifetime was 16 months at most. For a time a scheme to enclose the entire series of planes with roofing and siding was considered, but the solons in Harrisburg would not consent to the heavy expense.

Introduction of Wire Cable

John A. Roebling (1806-1869), already making a name as a bridge builder, had begun a community wire rope factory at Saxonburg, Pennsylvania. He suggested substituting his product for hemp rope, and a trial cable ran one of the Portage planes in 1842. In the face of fears that the new material would rust or turn brittle and snap, as well as quickly wear out the rest of the machinery, the wire cables gradually were accepted and installed on plane after plane. Political pressure, and even sabotage, were employed by those who had a good business supplying the Commonwealth with hemp, and it was six years before wire cable was adopted throughout the state system of inclined planes. By that time, the much-traveled Portage Railroad had outlived its usefulness, and locomotives were pulling up over the Alleghenies out of Altoona, completely under their own steam.

Back on the Morris Canal they had sprocket chain trouble in the hoisting machinery. Shortly after the canal was opened in 1831, the boat "Electa," from Rockaway, was bringing a cargo of iron down to Newark. Passing the summit of the 80-ft Boonton plane, the sprocket chain broke, releasing the cradle with the boat in it. The heavily-laden barge hurtled unchecked down the track, skipped and skittered across the basin like a small boy's stone, plunged headlong over the bank, and came to rest in the top of a tree. The captain's wife and two children aboard were unhurt. The lady commented that "The boat did come down right fast, but I thought maybe that was the way the thing always worked."

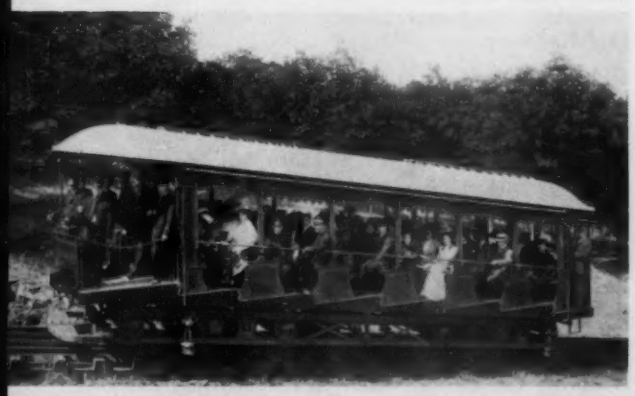
One of the inclined planes for canal boats on the Morris Canal, the first successful cable road built in the U. S.

Roebling's all-purpose wire cable soon replaced both chains and rope on the Morris Canal and on other planes in operation in the country.

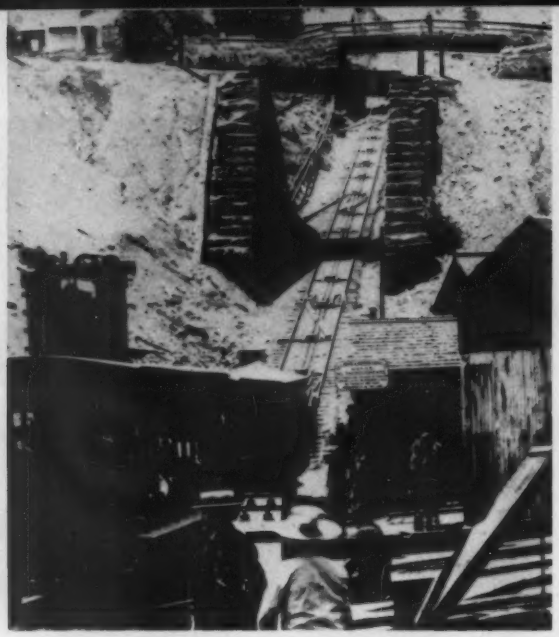
Inclined Railroads

Railroads of the 1830s which did not depend on canal connections also utilized the inclined plane with its hoisting apparatus, until locomotives were developed with enough power to drag a train uphill themselves. Long forgotten is the 2805-ft incline, with a rise of 187 feet, which took passengers out of Philadelphia from the Schuylkill River level toward Ardmore on the Philadelphia & Columbia Railroad. There were planes on the little pioneer Mohawk & Hudson, America's first railroad between cities, which hauled the flange-wheeled coaches up out of Albany and then let them down at the other end of the line into Schenectady. And at Mount Airy, Maryland, the Baltimore & Ohio Railroad used planes to surmount Parr's Ridge.

Three eastern Pennsylvania railroads used inclined planes, but added a further refinement. Through a system of cables, the weight of cars going down one side helped raise cars going up the other. On Mount Pisgah, at Mauch Chunk, was the 9-mile Mauch Chunk, Summit Hill & Switchback. The Pennsylvania



The Elizur Holyoke, one of the blue and gold electric cable cars that climbed the 21 percent grade up Mount Tom.



Inclined Plane Number 13, on old Delaware and Hudson Canal Co. Gravity Railroad, located near Honesdale, Pa.

Coal Company had a gravity line from Scranton to Hawley; and an elaborate 17-mile system, from Carbondale to Honesdale, was designed for the Delaware & Hudson Canal Company by John B. Jervis* (1795-1885).

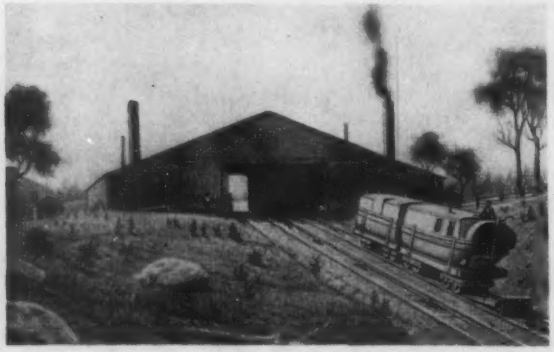
The earliest of these was the Mount Pisgah incline, built in 1827 by Josiah White (1781-1850), a talented Quaker with many other canal and bridge credits. In its first year, this gravity railroad carried 32,000 tons of coal from mines on the mountain to canal boats in the Lehigh Valley. Empty cars first were drawn to the top by patient, plodding mules. There the animals were placed in special vans, and sent rolling down the mountain along with the loaded cars of coal. To save time, the animals were fed enroute to the bottom, initiating the claim that the Mt. Pisgah was the first American railroad with a dining car. Rope haulage was installed on the incline in 1845; that in turn was supplanted by wire cable, using a stationary engine at the top of the plane.

Jervis's Gravity Road for the Delaware & Hudson required an ascent of nearly 950 feet in the first four miles, to reach a summit level on Moosic Mountain. Then there was an equal descent to the canal basin at Honesdale, where the cars of coal could be dumped into the company's boats. On the western side of the mountain were five long planes, operated by steam engines. The three on the eastern slope ran as a balancing act. When a train of cars was descending they were simply countered by a string of empties of slightly less weight going up, with their velocity controlled by friction brakes on a large fan wheel.

On the levels between planes, one of them six miles long, the company originally expected to use locomotives. Between Prompton and Honesdale, Horatio Allen (1802-1889) experimented with the famous "Stourbridge Lion" on August 8, 1829. This, the first trip of a locomotive on a regular American railroad, was a rousing flop — the engine proved much too unweildy for the roadbed and trestlework of the Gravity Road. So horsepower was used for many years, with the animals trained in uphill pull (even on the "level" there was always a slight incline). The hayburners became so accustomed to pulling uphill and riding downhill that they often balked at being hitched to a descending car which had been stalled temporarily by snow or ice.

The Gravity Road, with many improvements, including alterations in its planes and alignment, continued to carry both coal and passenger traffic until 1899. A trip on "The Gravity," either at Honesdale or Mauch Chunk was *de rigueur* for anyone taking the fashionable tour of the anthracite region in the 1880s. Mt. Pisgah's line continued as a scenic electric trolley route until 1934.

*Jervis also built the first Croton Aqueduct (CONSULTING ENGINEER, November 1960, page 94).



A canal packet boat being carried up the Allegheny Portage Railway. The boats split and went up in sections.

Cog Railways

Surmounting a steep incline with a cog or rack railway was another engineering accomplishment of the 19th century. The idea stemmed from English inventor John Blenkinsop (1783-1831), who was certain that the smooth driving wheels on a locomotive would never grip rails. To avoid the fancied slippage, he invented, in 1811, an engine drawn by a gear wheel meshing with a toothed rack alongside the rails.

The slight grades of the colliery road near Middleton, where the six English Blenkinsop locomotives were used, did not put them to a fair test of mountain climbing. The idea was shelved for 36 years. Then it was brought out again in Indiana, where the Madison & Indianapolis railroad was being built. The builders

of the line wanted the geared driving wheel for use on a 1¾ mile incline, stretching up from the Ohio River with a 1 in 17 gradient. Here, in 1847, the solid toothed rack between the rails was introduced, and eventually a special 54-ton Baldwin locomotive clung to it, and puffed grandly up the hill.

Not long after, Sylvester Marsh, of Chicago, planned a cog railway to the summit of Mount Washington, the highest peak in his native New Hampshire. Designing and perfecting machinery for the railway proved less of a problem than selling the idea of the line to the state legislature. The lawmakers in Concord felt they could no more charter a railroad to the top of Mount Washington than they could charter one to the moon.

Using $150,000 of his own money, Marsh set out to conquer weather and terrain problems that previous railroaders had not dared to tackle. The cog line inched determinedly up the granite face of the mountain. Trestles spanned open ravines and crossed sheer rock faces, buttressed by boulders too big to move out of the way. Finally, in 1869, three and one-third miles of seemingly perpendicular rail were opened to the public. The line has been a major New England summer attraction ever since.

The Mount Washington Railway is a cog road of the rack and pinion type. Between the regular pair of rails is a pair of heavy rails, joined by evenly spaced bolts. The whole resembles a ladder laid on the ground. The engine's drive wheel is a toothed gear, always in mesh with the rack. Ahead is pushed a passenger car, with a similar gear in mesh. There are special independent brakes on each axle, and a toothed wheel which ratchets to prevent backward movement. The grotesquely canted seats and drooping boiler assume normal positions as the climb begins. With steady steam pressure, the diminutive engines, amid the scratching of cinders and the clattering of ratchets, ascend the 6288-ft mountain in a little over an hour.

Roman Abt, a Swiss railway engineer, was a great admirer of Sylvester Marsh's handiwork. However, Abt improved on the design, staggering the racks so that the teeth of the cogwheels engaged a tooth in front on one rack before leaving the tooth behind on an adjacent rack. This increased the smoothness and security of the operation.

Abt built cog railways all over the world. Among the half a hundred which still use his system is the Manitou & Pike's Peak Railway in Colorado, the highest in the United States. This line, built in 1890, rises 7552 feet in 8¾ miles, a grade of 1 in 4.

Cable Cars

The Pike's Peak road was a departure from the trend at that time in this country. At the end of the 19th century, electric cable railroads were all the rage, and one could be found on virtually every mountain in the country which commanded a sweeping view.

Perhaps typical of these were two mountain railroads in Massachusetts, built, within sight of each other, at different periods. Both Mount Holyoke and Mount Tom, on opposite sides of the Connecticut River, had inclined railroads to famous resort hotels on their summits.

To reach the first rustic cabin atop Mount Holyoke, a 600-ft inclined railway was built in 1854, and enlarged some 13 years later. Steam-powered, the road had two small cars, each seating six persons, that were drawn by a 1½-in. manila rope. (Hardy souls who did not trust the cars could climb 522 steps to the elegant Prospect House at the top, but it still cost them 75¢ each.) The inclined railroad's popularity is evidenced by the fact that, from 1867 to 1870, a quarter of a million persons used it. Though comparatively small, the Mount Holyoke incline had a unique feature; its entire length was wood-enclosed, with handsome cupolas at intervals along the sloping roof to shed light in the long dark interior. An electric hoist replaced steam in 1926, but the motor burned out during World War II, and never was repaired. Heavy snow later collapsed the sheltering roof and wrote finis to this unusual inclined railroad.

Across the winding Connecticut from Mt. Holyoke stands Mt. Tom, whose sloping side was the site of a much more expensive and well-built railroad. This line, built in 1897, was an electric cable trolley, with electricity from a power house five miles away driving the motor. Heavy cables tugged the cars to the top of the 1202-ft mountain, with a turnout for passing halfway up. The cars were equipped with electric brakes, and a regulator-governed grip-brake could put an iron-jawed clamp on a third safety rail any time the cars exceeded normal speed. A 120-wire steel cable pulled blue and gold trolleys up the 21 percent grade to the Summit House.

Mt. Tom's superior construction was no match for the depression. The two cars, "Elizur Holyoke" and "Rowland Thomas," made their last trip on Columbus Day, 1936. Then they were left to the elements, vandals, and finally to scrap dealers.

Today, the mention of cable cars brings to mind the famed transport system which serves San Francisco. In addition, there are short pedestrian and auto-carrying inclined planes in hill-girt cities like Pittsburgh and Johnstown, Pennsylvania; and, at both Mount Washington and Pike's Peak, the cog railways are still going strong.

Near the dam which holds back Lake Hopatcong in New Jersey is a concrete shelter with a bronze plaque telling of the Morris Canal. Here is an old turbine which used to run an inclined plane, a fitting monument to James Renwick, the college teacher who started America climbing hills on rails. ▲▲

Prestressed Steel Design

PAUL ROGERS
Paul Rogers & Associates, Inc.

Prestressed steel cantilever trusses carry roof of United Air Lines hangar in Chicago.

PRESTRESSED STEEL remains virtually unused, while prestressed concrete is a commonly accepted construction material. This is true, in spite of the fact that some of the characteristics of prestressed steel offer possibilities for substantial savings and improved design. The concepts on which prestressed steel design is based can be understood by comparison to prestressed concrete. Concrete is prestressed in order to eliminate cracks in the tensile zones, to increase the workable cross section, and to gain added economy through the use of high tensile strength reinforcement. But prestressed concrete is also subject to shrinkage and creep losses which reduce the effectiveness of the stressing by about 20 percent.

CE exclusive

Prestressing of steel reduces the tensile forces in the truss members, inducing elastic cambers. Through elastic deformation, it reverses forces in the non-prestressed members. Thus, very substantial savings can be made, and the structure improved through the reduction or elimination of deflections and secondary stresses. There are no shrinkage and creep losses.

Obviously, any shape or form of steel structure may be subjected to prestressing. Some of these, designed by our firm, include: 145-ft cantilever roof trusses for the new United Airlines hangar at Chicago's O'Hare International Airport; a truss reconstruction for increased loading at an industrial plant of Procter & Gamble; a long span roof construction for an industrial plant; and a garage.

In its elementary form, a steel truss may be prestressed by attaching high tensile rods or cables

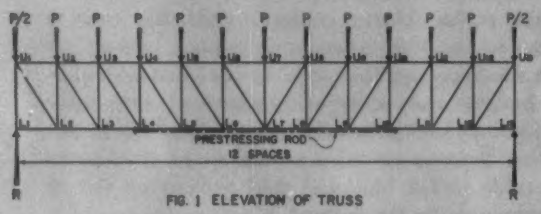


FIG. 1 ELEVATION OF TRUSS

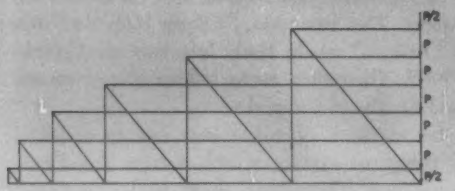


FIG. 2 FORCE DIAGRAM

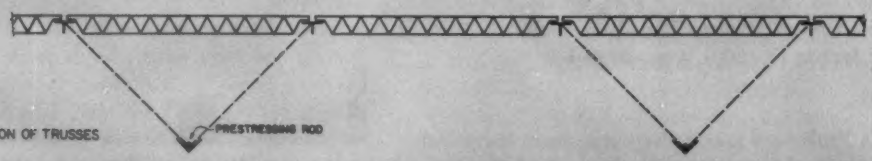
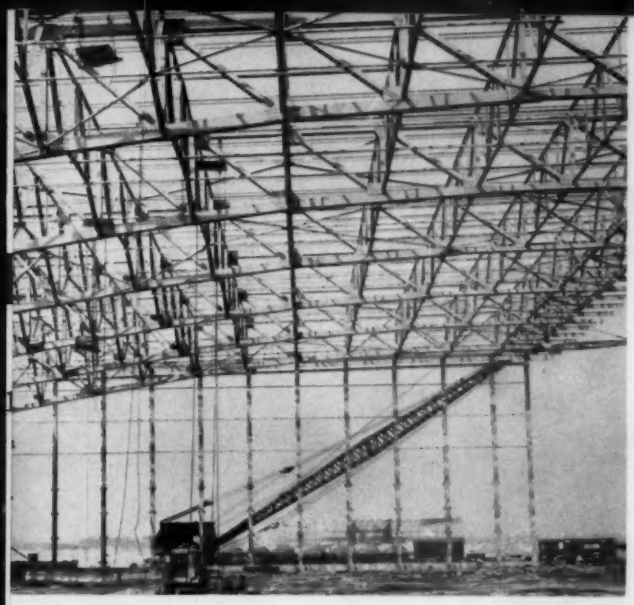


FIG. 3 CROSS-SECTION OF TRUSSES



alongside the tension chord, anchoring these to firm abutments, and tensioning them to a predetermined degree. Such a tensioning, as shown in Fig. 1, induces compression in the chord, and this compression diminishes, or eliminates, the tensional forces due to loads. Depending on the predetermined degree of prestressing, the forces indicated on the force diagram (Fig. 2) for the bottom chord are reduced by a corresponding amount. Consequently, the bottom chord members may be selected for the differential value of the tension force minus the prestressing force. With an approximate allowable tensile stress of 20,000 to 22,000 psi, and an allowable rod or cable stress of 100,000 to 140,000 psi, the amount of steel in the tension chord may be reduced to 1/5 or 1/7. In spite of the increased cost of prestressing members, the saving can be very substantial.

In order to minimize field labor, one bottom chord may be combined with two top chords as shown in Fig. 3. Such a triangular space truss is particularly effective, since it reduces the size of joists or subbeams and, being laterally stable, it eliminates the need for bottom chord bracing.

This prestressing method is fundamentally simple. The values of forces are easily established, the selection of members is routine, and a Williot-Mohr diagram can readily furnish a deflection diagram. Closer scrutiny will show, however, that there are latent forces, induced through prestressing, that are not detectable in the force diagrams, but which are very beneficial. In order to analyze such latent forces, a typical panel can be selected and the deformations and movements indicated on an exaggerated scale.

Movements Due to Deformation

Fig. 4 indicates that not only the prestressed bottom chord receives reversed forces, but that all the other members are subject to forces opposite to their normal action. Since such forces do not appear on the force diagram, their values must be computed from the geometry of panel deformations, taking into consideration the cross sectional areas and unit stresses in the panel being studied.

Our firm has built a model of a triangular steel truss. From repeated prestressing of the bottom chord we gathered convincing evidence that an upward elastic camber is produced during prestressing, bringing about a substantial increase of capacity.

When applied to new truss construction, prestressed steel allows unusually long spans and shallow depths at substantial savings over conventional designs. Applications include:

¶ Temporary prestressing of composite steel and concrete slab construction. Through prestressing, an elastic camber is induced in the beams. The concrete slab is then cast and cured. After the concrete has attained its full strength, the prestressing is released. As the beams deflect, compression forces, analogous to conventional prestressing, are induced in the slabs.

¶ Rehabilitation of existing railway bridges. Such bridges (numbering in the thousands), may have their capacities greatly increased through bottom chord prestressing.

¶ Relatively inexpensive elimination of existing columns of elevated structures is also possible, as required in roadway widening.

¶ Improvement of the utilization of material for long span rigid frames combined with reduction of side-sway corrections, as shown in Fig. 5. ▲▲

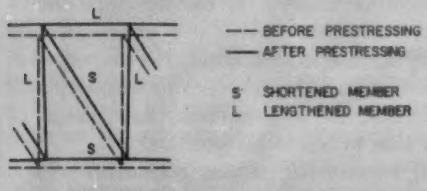


FIG. 4 MOVEMENTS DUE TO DEFORMATION

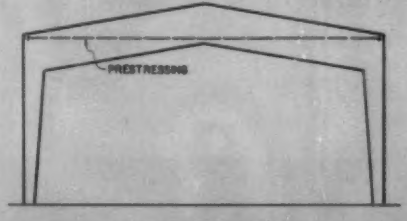
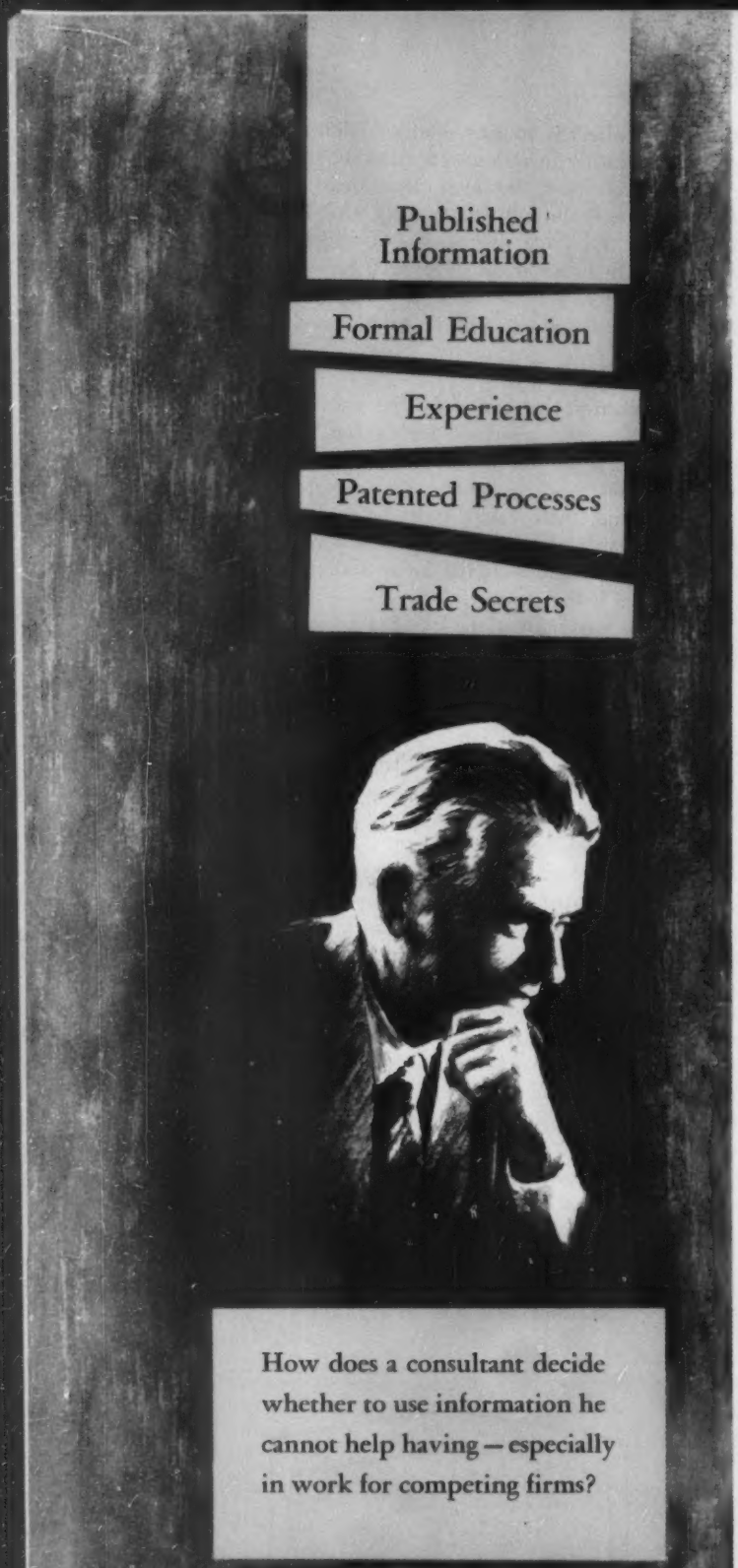


FIG. 5 RIGID FRAME



How does a consultant decide whether to use information he cannot help having — especially in work for competing firms?

Confidentia

Ethica

OF ALL CONSULTING ENGINEERS, the chemical engineer specializing in process design or in process development probably is the one most concerned with confidential proprietary information. He may have obtained such information while working for a former full-time employer, while working for a previous client, or while working for a present client.

CE exclusive

Recently, there has been much discussion of the problems arising when an engineer leaves the employ of one firm and enters that of another. A study of this subject was made by the Committee on Employment Conditions of the Engineers Joint Council, and a report submitted to the EJC Board on "Safeguarding Confidential Company Information." Court action has frequently resulted from the use of the private files, trade secrets, and know-how of one company by another. Thus, there has been a growing awareness that this problem exists, but little information has been developed to help the engineer in private practice establish an ethical philosophy.

Let us consider what the process consultant has to offer his client. He has his formal education and his knowledge of the literature — technical journals, transactions of professional societies, trade publications, and the patent art. In addition, he has the experience he has gained in industry, probably as an employee of one or more companies, in one or more categories, for a considerable number of years. During this time he has learned a great deal; he has gained information and know-how — general and specific — in various degrees of detail. He may have developed or assisted in the development of processes; he may have designed or engineered them; he may have operated them. No matter what the job, he obtained knowledge, experience, and information. Now, as a consultant, how much of all this is he able to use in his practice?

A chemical engineering process consultant with a wide practice serves many clients. Different types of problems arise and many different solutions are developed, based on data and information referred

WALTER LOBO, Consulting Chemical Engineer

Information . . .

Implications for Consultants

to him for study, evaluation, and use. Other prospective clients many approach him with similar or related problems. Which can he serve; which must he turn down? What type or class of confidential information from one client is he free to use for another, if any?

Compounding the problem is the ever-expanding industrialization of underdeveloped lands, where new opportunities frequently arise for the application of domestic processes. Can the consultant apply knowledge and information, protected by patent in certain countries, in other countries of the world where no such patents have been issued? Is he free to use all his available data in such places?

None of the questions posed here can be answered categorically, except in one way. There is one response that is always right but which is subject to extremely broad interpretation: "Be ethical!" Of course, we have codes of ethics for engineers and consultants to serve as guides, but these can hardly foresee all circumstances — they can only offer principles. Thus, only a good conscience can be totally reliable in answering these questions.

Patents and Secrets

Clearly, patented processes have their legal protection for the term of the patent. They have been publicly acknowledged as the property of their owners. Infringement of such patents, in those countries in which they have been issued, is ground for legal action. The patent information is public property; its legal use is subject to arrangement with the holder of the patent. Therefore, it is not patented processes which concern the consultant. Rather, he is concerned with the less clear area of trade secrets and know-how. This is the type of information and knowledge that is just plain savvy, specific but not patentable; or it is the closely guarded trade secret, unpatented so that little or no information is available to competitors.

An authoritative definition of the term "trade secret" appears in the EJC report already mentioned:

"A trade secret may consist of any formula, pattern, device, or compilation of information which is used in one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. A substantial element of secrecy must exist, so that except by use of improper means there would be difficulty in acquiring the information. Some factors to be considered in determining whether given information is one's trade secret are: (1) the extent to which the information is known outside of his business; (2) the extent to which it is known by employees and others involved in his business; (3) the extent of measures taken by him to guard the secrecy of the information; (4) the value of the information to him and to his competitors; (5) the amount of effort or money expended by him in developing the information; (6) the ease or difficulty with which the information could properly be acquired or duplicated by others."

So defined, a trade secret is the legal property of its owner, and he is entitled to legal protection. But sometimes trade secrets within an organization are really open knowledge outside the organization. If this is true, and the consultant gains his knowledge of them in an ethical manner, there should be no moral obligation to abstain from using them. However, when an employee leaves a company with knowledge of real trade secrets, he must recognize his obligation to protect the interests of his past employer. As a consultant he must not pass on the trade secret to his clients, nor offer his clients a process or plant design based on or employing that secret.

Acknowledging the proprietary ownership of a trade secret does not, of course, clarify the problem of recognizing just what such a secret is. Only analysis along the lines suggested in the quoted definition — consideration of the six factors and the careful weighing of each — plus, what is even more important, a highly ethical viewpoint, can answer the questions.

Information obtained by a consultant from his client is very definitely the property of the client. A consultant must recognize that he is placed in a position of special trust and confidence, for it is only in such a position that he can be expected to perform

well the services for which he is to be paid. He must guard his client's property — his secrets and his data — with care and solicitude. They are the consultant's to use only while he is working for the client. They never become part of his stock in trade.

Can most consultants be fully trusted with clients' confidential data and important trade secrets? The answer to this question is an unqualified yes, for otherwise there would be few consultants who could continue in practice. But there is always the outside chance that full confidence might be misplaced. Therefore, the client-to-be certainly should satisfy himself of the trustworthiness of his proposed consultant. Once having done so, he should feel that he can act accordingly, and willingly give him all the data and information needed to do the job in the best manner possible. If this degree of trust and confidence is lacking, the consultant should not be hired. On the other hand, the user of a consultant should not expect him to reveal any information about a previous client's process if it could be classified as proprietary or a trade secret.

Conflict of Interest

In terms of the conflict of interest issue, how can a consultant judge whether he may undertake work for a new client in a field similar or related to one in which he has worked or is working for another client? Or does he have to worry about it at all? Prohibition of all future work in the some broad field could be ruinous, but lines still must be drawn, and the six factors from the quoted definition again can serve as guides. Mentally, the consultant must separate his own general knowledge from secret know-how acquired from clients. If any doubt exists, he must resolve it in favor of the former client, or determine all the particular aspects of the matter and discuss them thoroughly with the former client — either to obtain his permission to take on the new work with the new client or to concede that such work would be prejudicial to the first client's interests. An open and honest discussion with all parties concerned will generate further confidence and insure that there is never cause for discontent or recrimination. It should not be assumed that all a consultant has learned from his past employers, or from his former clients, is useless on future consulting work. Experience is a valuable asset, and it includes not only specific information but general methods of approach as well.

The use of processes and methods, which are patented in the U. S. but not in other countries, does not appear to present much of a problem. In the countries where patents do not apply, they are just so much public information. If the consultant can offer the process with assurance that he has sufficient knowledge, honestly obtained, to insure the anticipated performance, there should be no legal or moral restriction on its use. If a trade secret, obtained by the consultant from a former employer or client, is in question, the fact that another country is involved has no bearing on its disclosure. The information remains a trade secret which the consultant is morally obligated to protect.

The Consultant's Position

The consultant's position best can be summarized by quoting from the "Manual of Practice for Consulting Engineers," prepared by the board of directors of ASCE and the Council of ASME, through their Joint Committee on Professional Practice Manual with the cooperation of committees of both societies. It states: "Confidential data — In some fields of engineering, especially where consulting services are rendered to industrial, manufacturing, process industries, and similar types of clients, the consulting engineer must be particularly careful to protect his client against the improper use of confidential information regarding processes, equipment, development, research, or other work, the divulging of which might injure the client. It is recommended that the consulting engineer concerned with such processes or manufacturing knowledge receive a formal release from his client before engaging in a similar activity with a competing organization. Where confidential manufacturing or process knowledge is involved, it is recommended that the client and the consulting engineer set forth in the contract for consulting services some provision for their mutual protection which will outline the procedure to be followed by the consulting engineer before undertaking similar engagements for other organizations, and specifying a reasonable time limit within which such restrictions should apply."

Section 14 of the Canons of Ethics of ASME also states that "he (the engineer) will disclose no information concerning the business affairs or technical processes of clients (or employers) without consent."

But, the foreward of these Canons presents the real essence of the matter when it states:

"Honesty, justice, and courtesy form a moral philosophy which, associated with mutual interest, constitutes the foundation of ethics. The engineer should recognize such a standard, not in passive observance, but as a set of dynamic principles guiding his conduct and way of life . . .

"As the keystone of professional conduct is integrity, the engineer will discharge his duties with fidelity to the public, his employers and clients, and with fairness and impartiality to all."

If the consulting chemical engineer makes these Canons his own, as he should, he can be certain that his clients will have confidence in dealing with him. He will be respected as a dependable, scrupulously honest, professional engineer. ▲▲

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1. Often, boilers can be modernized at a minimum of expense simply by installing a high-efficiency burner.
2. All packaged boilers do not operate with the same efficiency. You can't expect maximum return on your boiler investment if the boiler gives you efficiency only at certain firing rates.

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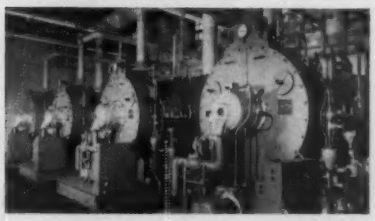

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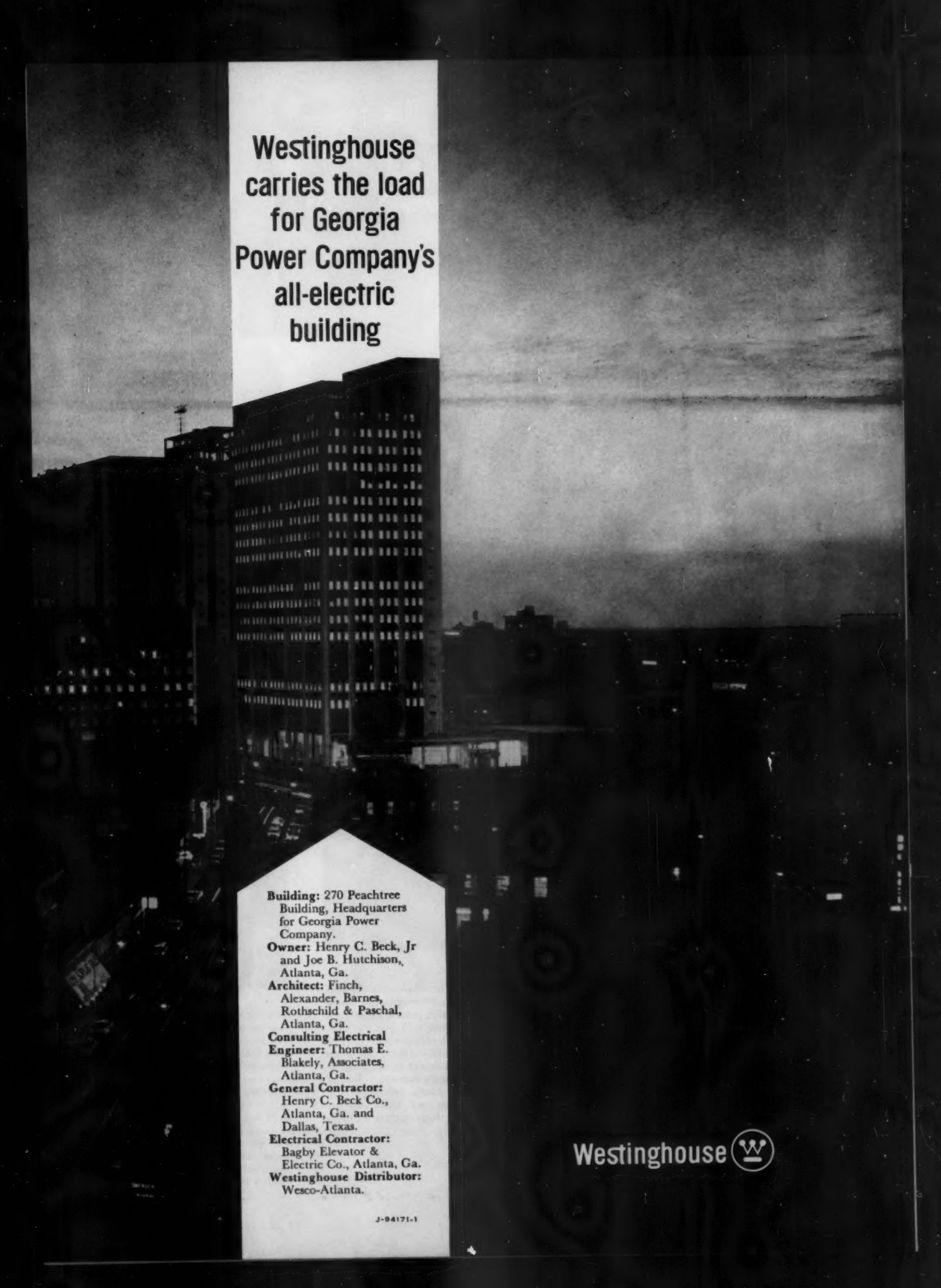


Westinghouse carries the load for Georgia Power Company's all-electric building

Building: 270 Peachtree Building, Headquarters for Georgia Power Company.
Owner: Henry C. Beck, Jr and Joe B. Hutchison, Atlanta, Ga.
Architect: Finch, Alexander, Barnes, Rothschild & Paschal, Atlanta, Ga.
Consulting Electrical Engineer: Thomas E. Blakely, Associates, Atlanta, Ga.
General Contractor: Henry C. Beck Co., Atlanta, Ga. and Dallas, Texas.
Electrical Contractor: Bagby Elevator & Electric Co., Atlanta, Ga.
Westinghouse Distributor: Wesco-Atlanta.

J-94171-1

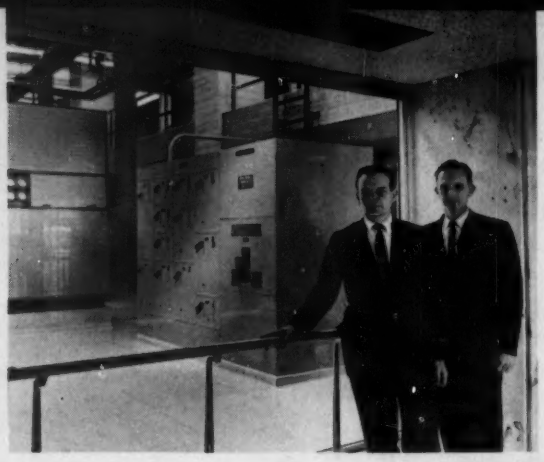
Westinghouse

Georgia Power Building

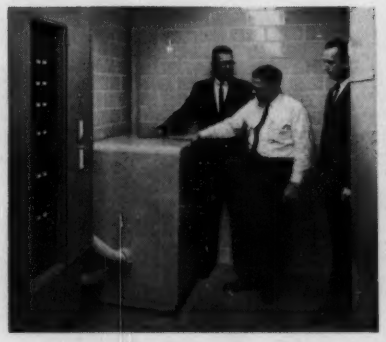
Atlanta

Designed with an all-electric concept, the 22-story **270 Peachtree Building**—Atlanta's newest skyscraper—serves as headquarters for the Georgia Power Company. Some of the electrical statistics:

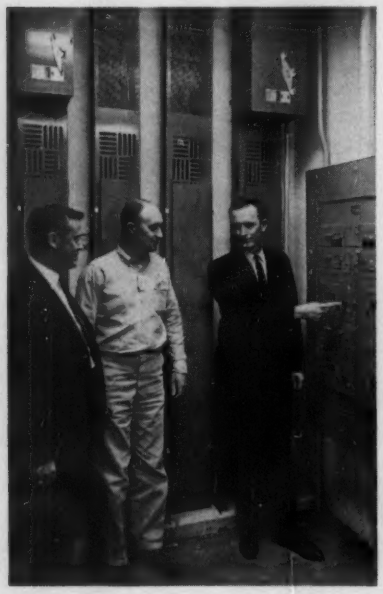
Service voltage—266/460
Service entrances—Two 4,000 ampere bus duct runs
Main breakers—Two 4,000 ampere, parallel
Connected load—8,000 kilowatts
Estimated demand—4,035 kilowatts
Air conditioning—1,000 tons (two 500-ton units)
Ninety kilowatts of lighting per floor
Eighty-seven kilowatts resistance heating per floor
Total electric load—23 watts per square foot in office areas



C. A. Alexander, Architect, and Earl Blakely, Consulting Engineer, shown in the handsome lobby of the Georgia Power Headquarters office building. Lobby was designed to showcase mechanical and electrical equipment and stress the importance of electrical services in modern office building operation. Westinghouse motor control center at right groups combination starting units into one structure affording flexibility, accessibility and safety. Modular construction features tilt-out design to isolate starters from bus for extreme safety in maintenance and inspection. This motor control center controls and protects mechanical room pump and fan motors.

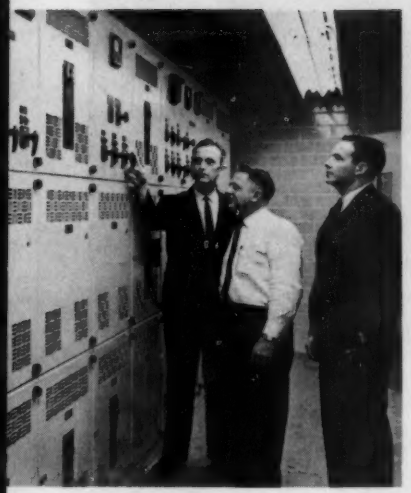


Discussing the low case temperature of a 300 KVA type DT-3 dry-type transformer are J. W. Tysinger, Westinghouse Sales Engineer; T. E. Luther, Building Superintendent and Earl Blakely. Silicone insulation in this class H (150°C) transformer offers greater resistance to heat . . . provides a greater range of safety for overloads . . . thus prolongs transformer life. This transformer steps 480 volts down to 120/208 wye for distribution. Westinghouse convertible type CDP panelboard at left contains De-ion® circuit breakers for positive protection against short circuits and over-loads.



J. E. Chambers; O. U. Moore, Jr., Contractor Job Superintendent; and Earl Blakely, discussing a Westinghouse motor starter panel. Two such panels are located on each of the building's 22 floors to control supplementary perimeter heaters. New motor starter panels afford grouping when a small number of circuits are to be controlled. Low-impedance bus duct runs at rear feed electric heating. Bolt on power take-off devices limit high fault currents available in the system, protecting all electrical devices.

Top view of low-voltage switchgear shows two runs of 4,000-ampere low-impedance bus duct handling incoming power and nine 800- to 1600-ampere feeder runs. Six of these runs serve as vertical rise feeders that carry full power to all building loads. Bus duct was specified for its flexibility for future load growth additions . . . also, bus duct has a lower installed cost than cable or conduit. A high degree of coordination was necessary on this job to insure equipment match-up. Westinghouse provided this coordination in a complete line of quality equipment.



Earl Blakely, T. E. Luther and J. R. Miller, Westinghouse Construction Engineer, discuss metering on main assembly of metal-enclosed low-voltage draw-out switchgear. Incoming power is fed into two main DB 100 air circuit breakers. Electrically operated DB-50 breakers serve as feeders and another is used as a tie breaker so that entire board may remain energized during emergency. Current limiting fuses are mounted in series with all breakers to protect against high fault currents available. Westinghouse DB breakers were specified, since so much of the building load is fed from each breaker that dependable service from a heavy-duty breaker is an absolute requirement.

J. E. Chambers, Vice President, Bagby Elevator & Electric Co., and H. H. Cook, WESCO, inspect a Westinghouse Life-Line combination starter. A convenient start-stop button is mounted in the cover of this size 1 Class 11-206 combination starter designed for across-the-line voltage starting. A type AB-I 100 ampere circuit breaker is mounted at right. This breaker utilizes the De-ion principle of arc extinction which stretches and extinguishes an arc faster, with less contact temperature rise than any known system.

J. J. McDonough, President, Georgia Power Company and A. H. Wade, Jr., Manager, General Services Department, entering one of six high-speed Westinghouse Selectomatic® elevators located in the building. Comfortable cars are finished in white decorator Micarta® and are equipped with intercom and music. They serve this 22-floor building quickly and efficiently at 800 feet per minute.

Lobby floor office area of Merrill, Lynch, Pierce, Fenner and Smith, comfortably illuminated by 2′ x 4′ Westinghouse Mainliner fluorescent fixtures. Mainliners are available in a variety of sizes and mounting arrangements with a full line of shielding media for complete flexibility. In this installation Owens Corning Polarizing Panel shielding was utilized to eliminate glare on the automatic stock board.

Specify Westinghouse for completeness of product line . . . for complete service—before, during and after construction . . . for complete dependability. *You can be sure . . . if it's Westinghouse.*

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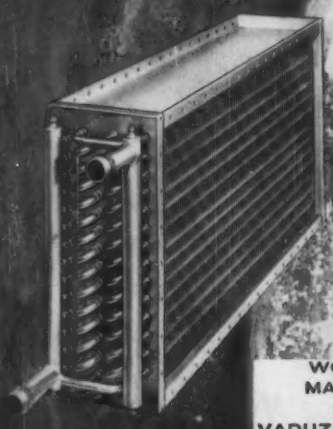
MARLO COILS SERVE ASSEMBLY ROOM FOR FIRST MANNED SPACE CAPSULE

Equipment Had Demonstrated Its Quality and Dependability In Previous Installations

The "Project Mercury" space capsule, designed and built by McDonnell Aircraft Corporation to carry a man in orbit around the earth, is assembled in a "Super Clean White Room" operated under incredibly stringent environmental and hygienic conditions.

The air handling system serving this special chamber at the McDonnell plant is equipped with Marlo heating and cooling coils. Why was Marlo selected for this installation? McDonnell plant engineer George [illegible] says, "We had used Marlo equipment in a previous [illegible] room. Our complete satisfaction with the performance of their units, plus their ability to deliver to meet our tight production schedules answered our coil needs for our space capsule assembly room."

Whether it's an unusual installation like McDonnell's "Super Clean White Room", or an ordinary type of heating or cooling project, you'll find the coils you need in the complete Marlo line. The Marlo representative in your area can give you detailed information.



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The Navy and Consultants

The Chief of the Navy Bureau of Docks and Yards prefers to use consultants.

REAR ADMIRAL E. J. Peltier is one of that rare breed of government officials – a man who favors using private consultants over the practice of empire building within his own agency. Admiral Peltier explained his policies on the use of consultants at a recent meeting of the American Institute of Consulting Engineers:

"Within the last few years, we have run from a low of about 800 architectural and engineering contracts at about $8 million in 1954 to a peak of over 1500 contracts and $30 million in contractural work in 1956 and again in 1957. By the end of fiscal year 1961, we expect to have executed almost $10 million in architectural and engineering contracts.

"The Bureau itself has an Engineering Division with over-all responsibility for the engineering and design effort. Essentially, this Division is concerned with development of design criteria, definitives, and guidelines specifications. This material is disseminated to our field engineering offices and constitutes the engineering ground rules under which they operate."

Firm Selection

"I am sure that you are interested in the procedures through which we obtain our architectural and engineering services from private firms. Each District Public Works Office maintains a file of brochures of architectural and engineering firms in its District, and in many cases, firms which may have special talents but are located outside of its District. When they receive a project which requires the use of an architect or an engineer, an advisory board called a Panel Committee reviews the brochures and determines which firms appear to have superior capabilities for the specific engineering work involved.

"This panel makes up a list of firms that varies from 3 to 10, depending upon the size and complexity of the project. Each of these firms is invited to send representatives to the District Public Works Office for an interview by a Selection Board, composed of key civil Engineers Corps Officers and civilians from that office.

"The Board interviews these representatives, explains the character and scope of the contemplated work, and seeks to determine the firm which appears to be best fitted to accomplish the particular job at that time. The selected firm is then requested to prepare a proposal (based upon the scope and other available data) and send representatives to negotiate a contract. Assuming that contract terms and a price satisfactory to both parties are arrived at, the contract for services is awarded. I want to emphasize at this point that the Bureau is interested in obtaining engineering services from any and all qualified firms."

The Bureau's Responsibility

"With regard to our responsibility to the consulting engineer, I can see the following: to insure that the firms who have expressed a clear-cut request to be considered

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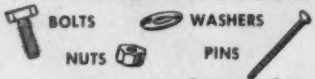

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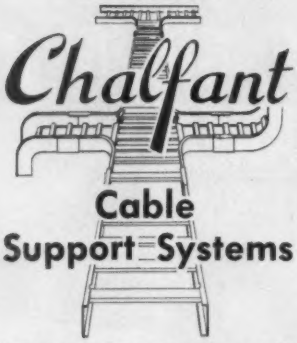

Cable Support Systems

Chalfant Splice Plates and Trays are securely fastened by the exclusive Chalfant Crimping Method . . . to reduce installation time way below conventional methods. Lower costs are also achieved with Chalfant systems because each splice plate and tray is made from high quality, longer lasting, economical Aluminized steel.
You'll save 15% on material and 40% on installation when you use Chalfant Systems to produce a better job.

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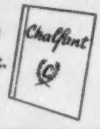

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Tile Structures

Design,
Construction
and Maintenance

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ENGINEERING AND
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for prospective work are, in fact, considered; and to insure that the selected firm is the firm with the greatest competence for the job.

"This involves a determination of the relative standing of the competing firms with regard to such factors as quality of work accomplished in the past for the specific DPWO, other DPWOs, the Bureau, the Army, other Federal agencies, and the engineering community at large; experience in the design of the type of facility being considered for design; available staffing of the firm with the precise skills required for the job at hand — and the degree to which these people are loaded up with other work; and location of the design office.

"Our third responsibility to the consulting engineer is to insure that all available pertinent information is provided to assist him in preparing an intelligent, complete, and realistic proposal. Also, it is our responsibility to insure that you, as a consulting engineer, are paid an adequate and reasonable fee for your services.

"Finally, we must insure that once the contract is let, you receive the utmost in cooperation from us to enable you to complete the contract expeditiously. This means that you must be provided with adequate information as to the Navy's requirements, and when you submit drawings for review, such review is made by competent government engineers with a minimum of delay."

The Consultant's Responsibility

"Now, as to the responsibility of the consulting engineer to the Navy . . . we expect that the consulting engineer is going to put forth his best design effort. This involves a complete site investigation at the initiation of the project, the use of the latest and most up-to-date methods, the employment of an adequate number of personnel for the task, the utilization of the best engineering talent, the prompt initiation of work, and the faithful pursuit of the tasks contracted for until timely completion of the project.

"It does not contemplate the use of canned design work.

"Another important responsibility of the consultant is the checking of shop drawings. The shop drawing approval stage is most important. We expect the same high caliber talent used for the original design to be used for checking shop drawings of critical areas of the project.

"Next, the consultant must provide support during the construction phase of the projects, as errors in design or latent conditions requiring a change are uncovered.

"Finally, it is generally required that as-built drawings be prepared. Nothing less than a faithful, conscientious, accurate job is acceptable here."

Saving Money

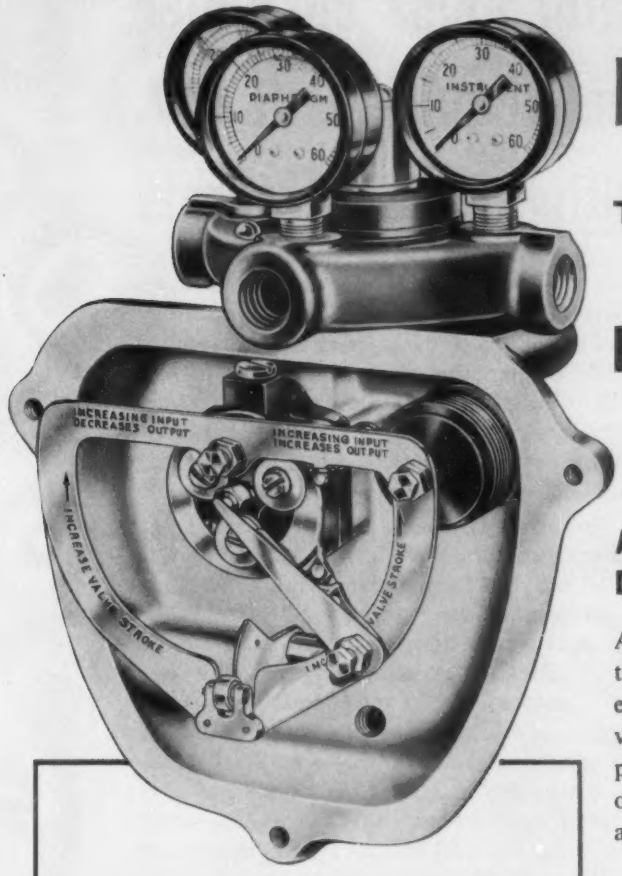
"One of the biggest challenges today to the consulting engineer is the requirement for obtaining more construction for less money. This is a challenge with which the Bureau is faced and which we, in turn, throw to you.

"This leads me to a very important area — resulting in savings of dollars. I mean low maintenance costs. Your designs that require low maintenance result in more dollars available for missile systems. Your contribution is direct — and varies with your skill.

"Maintenance problems have to be nipped in the bud. This is where the design engineer comes into the picture. He must keep himself informed of the character and nature of maintenance problems. He should also consult maintenance specialists during the course of the design.

"On our part, we are incorporating low maintenance factors into our design definitives and criteria. The major contribution, however, must be made by you — the consultants and designers." ▲▲

A new concept in design makes possible the...



FISHER

TYPE 3560 VALVE POSITIONER

V/P

Assured product performance through DYNAMIC ANALYSIS engineering

Application of mathematical techniques of design to pressure control systems has enabled Fisher to eliminate the conventional approach in the development of the new V/P valve positioner. It has provided the V/P with the following combination of characteristics and performance . . . unobtainable in any other type of valve positioner.

SMALL AND COMPACT . . . only 6⅜" wide and 8¾" high (with gauges).

CONVENIENT ADJUSTMENT . . . valve stroke and zero adjustment readily accessible and easy to make.

SPLIT RANGE . . . no parts change whatsoever is required for split range operation.

EASILY REVERSIBLE . . . reversed by simply moving flapper arm from one beam quadrant to the opposite quadrant.

CHARACTERIZED CAMS . . . offer wide flexibility in valve characteristics.

PERFORMANCE DATA

Hysteresis, (Average)	0.0012"
Linearity	as required. Change cams to obtain desired characteristics
Sensitivity	0.14 psi
Resolution Sensitivity	0.002 psi
Repeatability	±0.0003"
Stroking Speed	0.37 in/sec.
Air Consumption	10 scfh
Break Frequency (5% of instrument pressure range)	3.9 cps
Break Frequency (3% of instrument pressure range)	4.6 cps

The above performance data was taken from laboratory tests on a Type 657 diaphragm actuator, Size 40, with 1½" travel. Instrument range 3 to 15 psi.

Write today for Bulletin E-3560

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

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BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

Steel fabricator helps customer reduce steel requirement 14% with A36 Structurals

Architect: Donald E. Stoll, A.I.A., (left) and Robert G. Graham, Jr., design engineer for McMurray Structural Steel Co., both of Nashville, Tenn.

These new 16-inch, wide-flange lightweight sections at 31 lbs. in A36 Steel were used in lieu of the 16-inch, wide-flange sections at 36 lbs. necessary in A7 Steel.

"Dominion Electric Corporation's new manufacturing plant in Gallatin, Tennessee represents the Southeast's first combination of the advantages of A36 steel, lightweight sectional structure, and the plastic method of design," says Mr. Donald E. Stoll, architect for the project. "Plastic design makes the total steel area one of working strength."

Mr. Robert G. Graham, Jr., design engineer at McMurray Structural Steel Company, Inc., fabricators of all the steel for the plant, said, "Specifying A36 Steel for our beams reduced our structural steel requirements by six tons and cut approximately $1,500 from our costs. Structural steel in this project consists of 36 tons of beams and 10 tons of structural grade pipe, used as columns. In addition, there are 85 tons of bar joist purlins made of A7 Steel. These were not available in A36 at the time we started work, but if they had been, they would have saved us even more. We used 36 tons of A36 beams and we would have needed 42 tons of A7 for the job—a saving of 14% on the beams."

All the steel, including the new weight-saving structural shapes recently introduced, was supplied by the Tennessee Coal & Iron Division, United States Steel. A36 Steel with its higher yield point of 36,000 psi, costs very little more than A7 Steel.

The plastic concept of design, so important on this project, is based on the ultimate load capacity rather than on initial yielding. Mr. Stoll said, "It is being used extensively where sound, economical steel design is the objective." Mr. Graham also estimated that the plastic concept resulted in a *50% saving of design time* on this project. For more information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. USS is a registered trademark.

United States Steel Corporation • Columbia-Geneva Steel Division • National Tube Division • Tennessee Coal & Iron Division • United States Steel Supply Division • United States Steel Export Company

USS **United States Steel**

New plant of Dominion Electric Corporation, Gallatin, Tennessee, under construction by General Builders Corporation, Nashville, Tennessee. Higher strength USS A36 Steel Beams saved 6 tons of steel. Note simplicity of design.

This mark tells you a product is made of modern, dependable Steel.

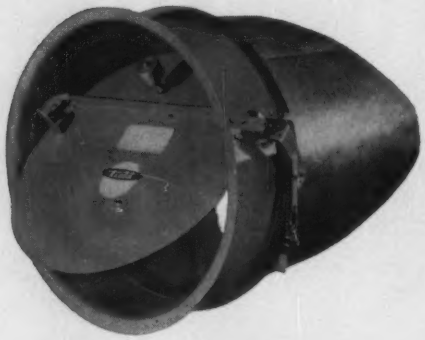
Don't design a

DRAFT SHORTAGE

into your

GAS BOILER

installations



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*With a Field the draft assistance of the chimney becomes available to the boiler for abundant draft at all firing rates, precisely controlled to the optimum twelve-to-one air-to-gas ratio recommended for clean, bright, efficient combustion. For 5" through 34" flue outlets. Write for specification data.

Specify Field Draft Controls for gas, gas-oil, oil or coal, for boilers, furnaces, incinerators, with natural, forced or induced draft, 5" through 34" flues.

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Conco Engineering Works, Inc., Mendota, Illinois

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Chicago Tramrail Division — "Trak-Rak" Stacker Cranes, Monorail Systems, "Fas-Lok" Storage Racks.

More Asphalt than Concrete

According to figures compiled by the Asphalt Institute, the total mileage of asphalt paving on the state highway systems has virtually doubled in the past 15 years. At the same time, the total mileage of portland cement concrete surface roads has decreased steadily.

The Institute reports that asphalt mileage increased from 242,000 in 1945 to over 478,000 in 1959. In the same period, portland cement concrete pavement decreased from 95,000 miles to just under 67,000 miles. A large portion of this change is due to the practice of changing a road's listing when it is re-surfaced. Thus, much of the total mileage for asphalt pavement is really concrete pavement which has been resurfaced with asphalt.

AASHO Road Test

The Executive Committee of the Highway Research Board has reprimanded officials of two industry associations that have published statements claiming to contain significant results of the recent road tests by the American Association of State Highway Officials.

The test, administered by the Highway Research Board, is the largest and most comprehensive road test ever conducted. It is a long-term scientific study of the performance of asphalt concrete pavement, portland cement con-

The High Spots

crete pavement, and various designs of short-span bridges. The tests began in October 1958, and consisted of the repeated passage over the test area of vehicles with known loads.

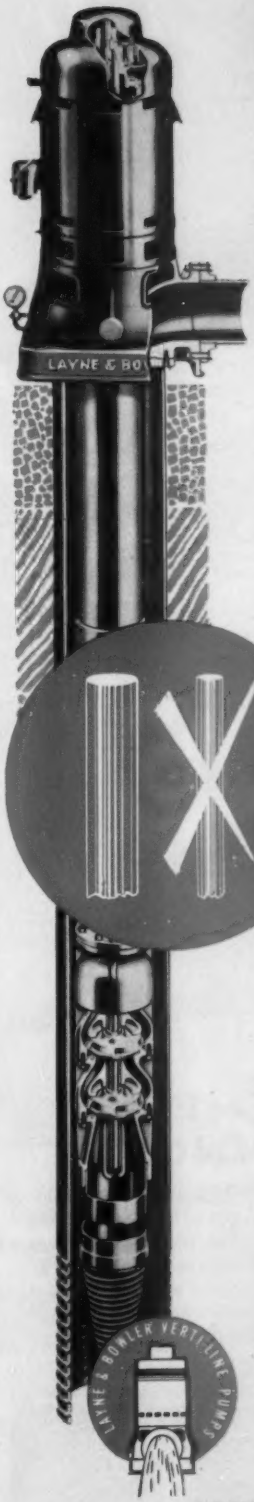
According to the HRB, all parties to the test agreed it was in the common interest not to divulge test results prior to their evaluation and publication by the HRB. Committee members ruled that the officials of two associations had violated the terms of the agreement, and reprimanded them accordingly.

Prestressed Concrete Bridges

According to the U.S. Department of Commerce, new bridge construction in 1960 showed a definite increase in the use of prestressed concrete. In 1960, over 12 percent of all highway bridges built in the country were prestressed concrete – a a gain of about 3 percent over the previous three years. To date, highway departments in 46 of the states have used prestressed concrete for bridge work; the only exceptions are Alabama, Maine, New Hampshire, and Vermont.

Epoxy for Bridges

Engineers at the Experiment Station of the University of Arizona are reporting amazing success in the use of epoxy resins as structural bonds. In recent tests, a 4-ft by 21-ft composite steel and concrete slab beam was joined with the



Another Reason You're Money Ahead With
Verti-Line Pumps

LARGER-Than-Standard Shafting Minimizes "TWIST-OFFS", LENGTHENS PUMP LIFE!

When you specify Layne & Bowler "Verti-Line" Pumps you are buying pumps built to standards far beyond those used for conventional vertical turbine pumps. For example, in "Verti-Line" Pumps tougher, longer-lived "Moly" Iron is standard construction *at no extra cost.* The unique Perihedral 2-Way Pump Seal is another extra-performance feature built into every "Verti-Line" Pump. And still another is the much heavier pump shafting used in all "Verti-Line" Pumps...

The Pump Shaft in a vertical turbine pump is one of those critical parts you can't see — but its size and construction mean a lot in the performance you get. The pump shafts in "Verti-Line" Pumps are not only made of carefully-selected alloy steel — the best available for the purpose — but are also considerably larger in cross section than are the shafts used in most other pumps.

Larger pump shafting means larger bearing surfaces, a steadier-running pump, and much less risk of "twist-offs" or maintenance problems when sudden loads are placed on the impellers—or when the impellers strike debris in the fluid being pumped. This is one more of the many hidden "extras" you get when you specify Layne & Bowler "Verti-Line" Pumps—the pumps that are built *up* to performance, not down to competition. Yet you pay no more for the extra values built into "Verti-Line" Pumps. In fact, you actually pay *less* because of the longer life and lower maintenance these quality pumps provide!

"Verti-Line" Pumps are available in a complete range of sizes... 20 to 10,000 GPM—1½ to 1000 H.P. — Heads to 650 ft.

Send for "Verti-Line" Bulletin #1100 that gives helpful details on these advanced vertical turbine pumps!

Verti-Line Pumps are the exclusive products of

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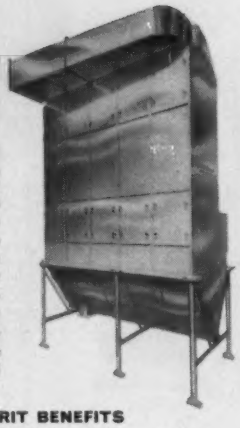

NEW TORIT DUST COLLECTOR IS AUTOMATIC!

Save real dollars with the benefits from this automatic dust collector. No more interruptions on production lines! Maintenance problems are practically eliminated. This all new continuously cycling TORIT dust collector automatically cleans your air and automatically shakes its own filters and blows them clean with reverse air flow. Collected material is emptied automatically.

OTHER EXCLUSIVE TORIT BENEFITS

- automatic filter-shaker mechanism is simple, maintenance-free
- different dusts may be collected separately
- highest air-to-cloth ratios (from 5 to 25:1) and longer filter life
- only ¾ H.P. required for fully automatic operation
- polished ⅜" aluminum construction for minimum floor loading
- modular design—5' wide x 4'-5" long (for two sections) x 15'-6" high—saves space, lends ease and versatility to installation. Use up to 12 modular sections for each application! No limit to CFM capacity!

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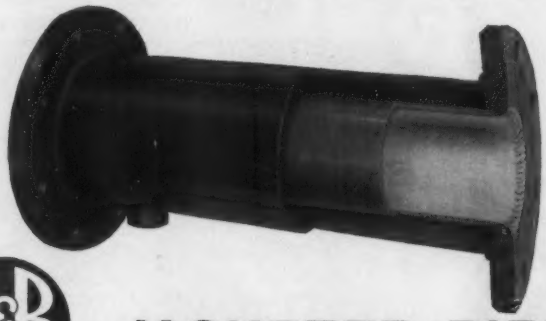

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H&B standard jacketed equipment gives complete jacketing of the product line. Special jigs enable H&B to insure uniformity of the jacket area. Fittings and valves are available in cast or welced construction in all alloys including stainless steel. All H&B jacketed equipment is hydrostatically tested to 450 p.s.i. H&B welded steel jacketed fittings are ideally suited for process piping with pressures reaching 300 p.s.i. and temperatures up to 750°F. . . . For more information send for bulletin J-57.

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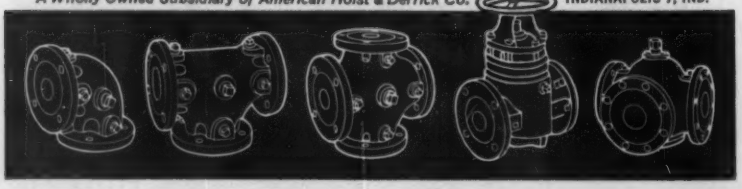


adhesive epoxy, then tested to breaking. The beam withstood a load of 70 tons before cracking.

Dr. G. M. Nordby, head of the University of Arizona Station, said that bridges built with epoxy might provide greater resistance to repeated loading than those built with steel studs.

Another series of tests is being conducted, bonding precast concrete to steel beams. Dr. Nordby saw this as a possible substitute for pouring concrete in forms around steel superstructures.

Laminated Glass

A report from Prague, Czechoslovakia, indicates that the Institute of Theoretical and Applied Mechanics of the Czech Academy of Sciences is testing laminated glass as a building material. The new Five Year Plan calls for use of glass and polyester laminates in the construction of 25,000 housing units. The material will be used for ceilings and roofs.

Environmental Research

The American Society of Heating, Refrigerating and Air-Conditioning Engineers has concluded an agreement with Kansas State University, whereby the school will take over the controlled environment study program begun several years ago by the Society. Terms of the agreement include transfer to the Kansas State Campus of the ASHRAE test facilities, now located in Cleveland. The school will set up a new branch, called the Kansas State Environmental Research Center.

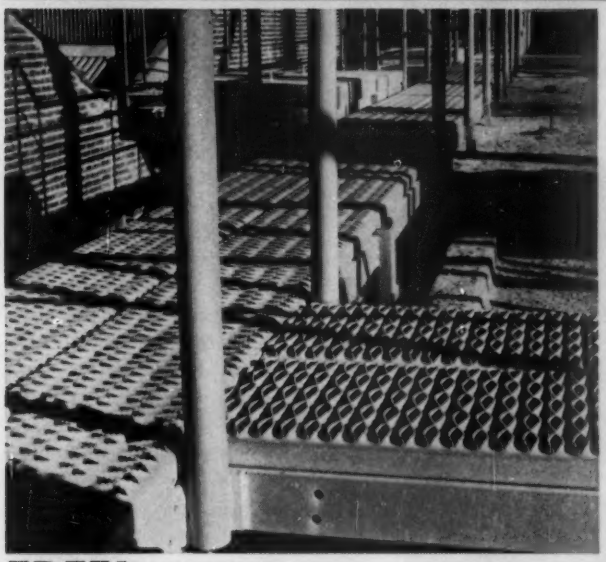
This is the first major disposition of research facilities since ASHRAE decided last December to expand its program of grants-in-aid and to close down its own research laboratories. The $150 thousand Cleveland facility will be disassembled this summer, and transported to the campus at Manhattan, Kansas.

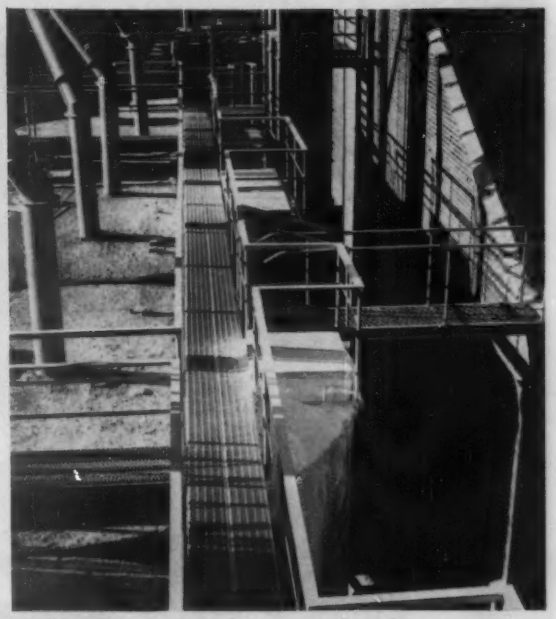
ACI Grant

The American Concrete Institute has made a $2000 grant to the Re-

CATWALKS ... *anyone?*

See how Owens-Illinois solved their catwalk problems at their **LIBBEY GLASS PLANT** at Toledo with GLOBE'S *Safety* **GRIP-STRUT** PATENTED





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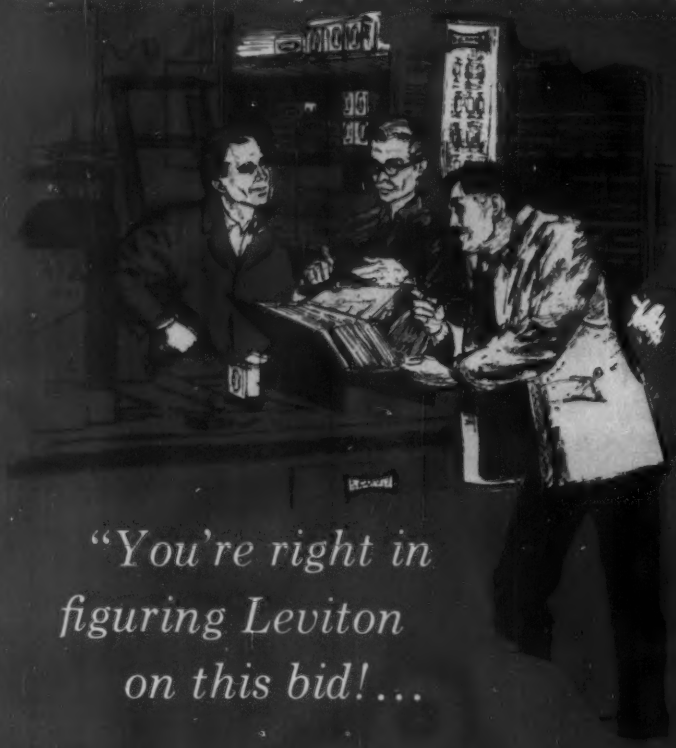
LEVITON QUALITY TALKS

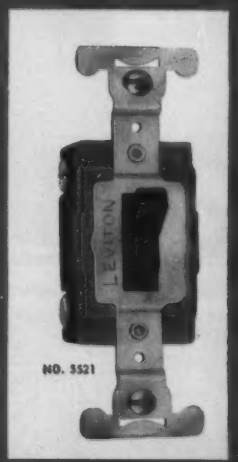


"You're right in figuring Leviton on this bid!..

Darn right! I've been very happy with Leviton on the last two jobs. And this may mean the third."

This typical wholesaler-contractor conversation at bid time is being repeated 'round the country. Leviton's line of specification grade devices have caught on.

Everyone is pushing Leviton because of the delivery, the price, the completeness of line and the consistent quality. Architects and engineers have the confidence to specify Leviton on their biggest projects.



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HIGH CAPACITY will accommodate the high lamp/fixture loads of fluorescent systems, or full rated capacity of tungsten filament lamp loads. Take full load currents up to 80% of the switch rating for motor control.

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Contact American Insulated Wire Corp., Pawtucket, Rhode Island, a Leviton subsidiary, for a complete line of insulated wire and cable products.

inforced Concrete Research Council, and is considering additional support in next year's budget. The Council, organized in 1948, finances research projects in several engineering schools and laboratories, and plans to expand its operations and activities.

The ACI representative to the RCRC is Raymond Reese, head of the Toledo, Ohio, consulting firm of R. C. Reese and Associates.

Increased d-c Use

Delegates to the Summer Meeting of the American Institute of Electrical Engineers last month discussed the possibility of using direct current for the transmission of electric energy within the next quarter century. The idea was brought up in a paper presented by two engineers of the Dow Chemical Company. They pointed out that, by 1985, the installed generating capacity of this country may be as high as 875 million.

Their report stated, in part, ". . . there will be continued pressure to strengthen transmission and distributing systems, and to increase the maximum load that can be handled by individual cable lines. While detailed developments of conventional designs can be expected to effect some improvement, these advances are unlikely to be adequate, and it would appear that some radically new solutions are essential. Since such developments will tend to be long term and expensive to bring to fruition, the target should be well chosen.

"Since the increased powers that have to be handled call for the use of even higher voltages for transmission, direct current . . . will come into its own. In Europe, experience is being gained in the operation of a d-c transmission technique. . . ."

UN Energy Conference

The United Nations Conference on New Sources of Energy will be held in Rome, Italy, August 21-31. The term "new sources" may be

Decatur Office of The Illinois Power Company uses a 100 ton York Water Chiller, installed in a narrow "L" off basement storeroom, to cool 13,000 sq. ft. of building area. W. D. Hill, Building Maintenance Supervisor, expects the new system to "save about 15 to 25% on maintenance costs."

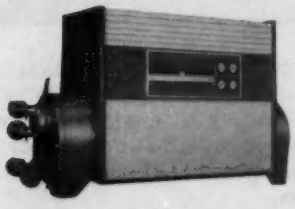
YORK Turbopak Water Chiller fits waste space ...slashes installation and maintenance costs

COMPACT, HERMETIC CENTRIFUGAL—A 130-ton Turbopak is only 14′ long, 5′ deep and 6¾′ high, nearly 50% smaller than previous designs. Exclusive Borg-Warner power transmission reduces compressor rotor size to save space.

AUTOMATIC CAPACITY CONTROL—Pre-rotation vanes provide efficient capacity reduction to 5% of full load. This continuously variable control matches compressor capacity to air conditioning load, assuring maximum system performance.

COMPLETELY FACTORY PACKAGED—To cut installation costs, the Turbopak is completely factory assembled, insulated, piped, wired, charged, tested. It's shipped and rigged as a single unit—no assembly or refrigeration piping on the job.

ULTRA-QUIET OPERATION—Runs more quietly than water pumps that supply it. Vibration-free operation permits location anywhere. "Push-button" controlled from convenient electronic control center. 65 tons refrigeration and up.



"Our YORK Hermetic Turbopak Centrifugal Water Chiller", says W. D. Hill, "has no open shafts to catch trouser legs; no grease pans to catch droppings from motors; no open control panel to be careful of; and no maze of pipes to confound maintenance employees. It is a neat and attractive package that you don't mind having someone see!"

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misleading; the "new" applies to the methods used to harness age-old energy sources. The conference will consider three distinct items – solar energy, wind energy, and geothermal energy.

The major objective of the UN in sponsoring this meeting is to find ways of bringing additional power, heat, and light to the undeveloped areas of the world – areas where all work is done by hand. Man and animal power is probably the least efficient utilization of energy, producing as little as one-twentieth the work per unit of energy that industrial power sources produce.

The discussions of solar energy will center on two points: the direct utilization of heat in solar pools and solar furnaces; and conversion to electric power in solar batteries. The question of harnessing wind-power is a little different – windmills already have been refined to a high degree. The question here will be to find out where they can be utilized most effectively. The discussion of geothermal energy is expected to draw the most interest, because of recent spectacular gains in the harnessing of underground heat.

Bid Registry

A plan to eliminate or at least limit the effects of bid shopping was introduced recently by the Detroit architect-engineer firm of Harley, Ellington, Cowin and Stirton, Inc., on behalf of their client, the University of Detroit. Subcontractors bidding for parts of the work on the new U of D Lansing-Reilly Hall were required to submit copies of their original bids to a registry office, where all bids were kept sealed. Then, when the work had been let to a general contractor, his figures for the subcontracting work were checked against the registered bids from the successful subcontractors. Sponsors of this plan say they believe it discourages attempts by general contractors to shop for lower bids and by subcontractors to try to peddle lower bids.

Ethical Practice

A Jordan firm, the Arab Potash Company, has invited proposals for consulting engineering services on the construction of a new $18 million potash plant on the shores of the Dead Sea. Officials of the company point out that this will not be competitive bidding, since the selection of the consulting firm will be solely on the basis of professional experience and ability. However, they still expect to get prices with all the proposals. The professional societies in this country are tending toward the view that U.S. firms should conduct themselves abroad in accordance with the established professional ethics of the country in which they are working. Ethics in a country such as Jordan, with few domestic consulting firms, may not be firmly established, or nonexistant. One code sure to be in effect is the law of the jungle. ▲▲

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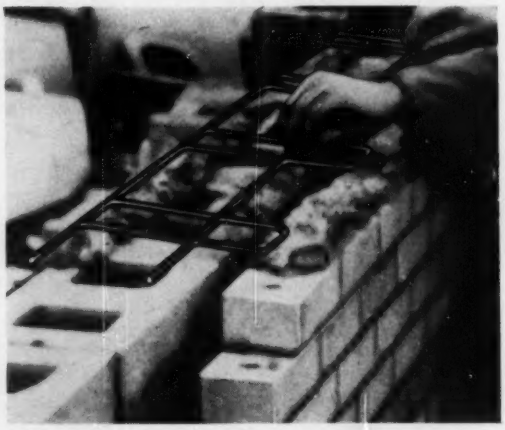
(Both Face Shells Shrink Equally. Both Face Shells Must Be Reinforced)
ACHIEVE HOMOGENEOUS BOND



Made of all 3/16" wire or all #9 wire. Made in 12 foot lengths with 4" wide box ties 16" O.C. (9 ties per length). Available finish: Galvanized box ties with brite basic side rods; all mill galvanized wire; hot-dipped galvanized after fabrication.

AA WIRE PRODUCTS COMPANY
714 E. 61st Street
Chicago 37, Illinois Phone: Midway 3-8203

Name_____
Address_____
Firm_____
City_____ Zone_____ State_____

Please send me B.O.C.A. Report No. 60-1 ☐
1961 Sweet's Brochure ☐

CE 7-61

*Pat. Pending © 1961 AA WIRE PRODUCTS COMPANY ® REG. U.S. PAT. OFC.

"EASIER" Is the Word for Armco Steel Water Pipe

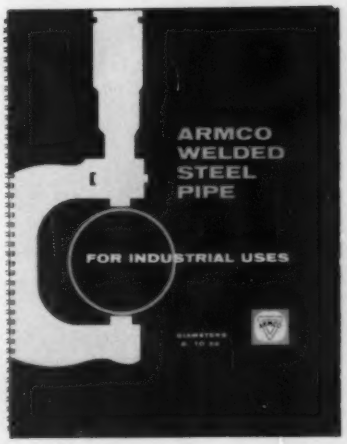
Steel
Strength
Economy
Durability

Designing lines is *easier*, because both standard and special fittings are available with Armco Pipe.

You'll find it *easier* to specify high quality, because Armco Pipe is made to nationally recognized specifications.

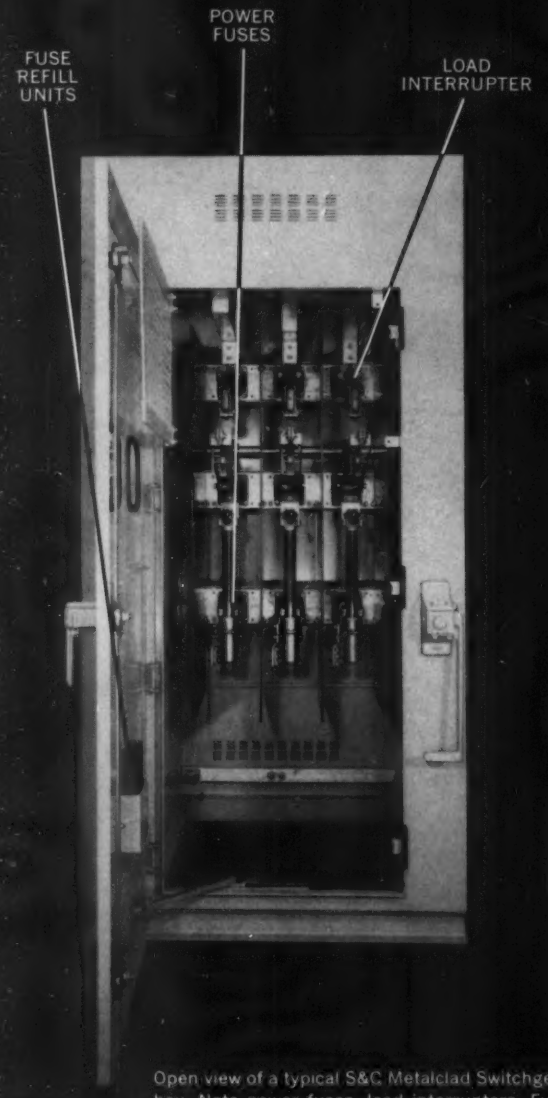
Then too, it's *easier* to get the exact size because diameters range from 6 to 36 inches with a choice of wall thicknesses from 7/64- to ½-inch.

It's also *easier* to get complete facts. For your copy of the 40-page Armco Manual, No. 8558, just tear out this page, write your name and address in the white space, and mail to us. Armco Drainage & Metal Products, Inc., 4221 Curtis Street, Middletown, Ohio.



ARMCO Drainage & Metal Products

Reclosing is for the birds



Open view of a typical S&C Metalclad Switchgear bay. Note power fuses, load interrupters. Fuse refill units are conveniently stored in the door.

So why buy this feature in your 2.4 thru 14.4-kv switchgear?

Reclosing is for the birds, squirrels, tree limbs, lightning, icing, windstorms, and kite strings that frequently cause non-persistent faults on open distribution lines of utility systems. Reclosing re-energizes the lines to restore service in a fraction of a minute.

But when faults occur on the enclosed power supply circuits of industrial plants, commercial and institutional buildings, you don't want to reclose on them. These faults —while extremely rare—are permanent. Someone has to locate the trouble and repair the equipment or cable—or at least isolate it—before the system can be re-energized. So why buy expensive circuit breaker type switchgear with its automatic reclosing feature?

S&C Metalclad Switchgear—employing fused load interrupters—gives the ideal protection for enclosed power supply circuits. Power fuses furnish the fault protection (load interrupters switch the load). After a fault occurs, you simply replace the inexpensive fuse refill unit (typically costing $13.50) while the fault is being located and corrected.

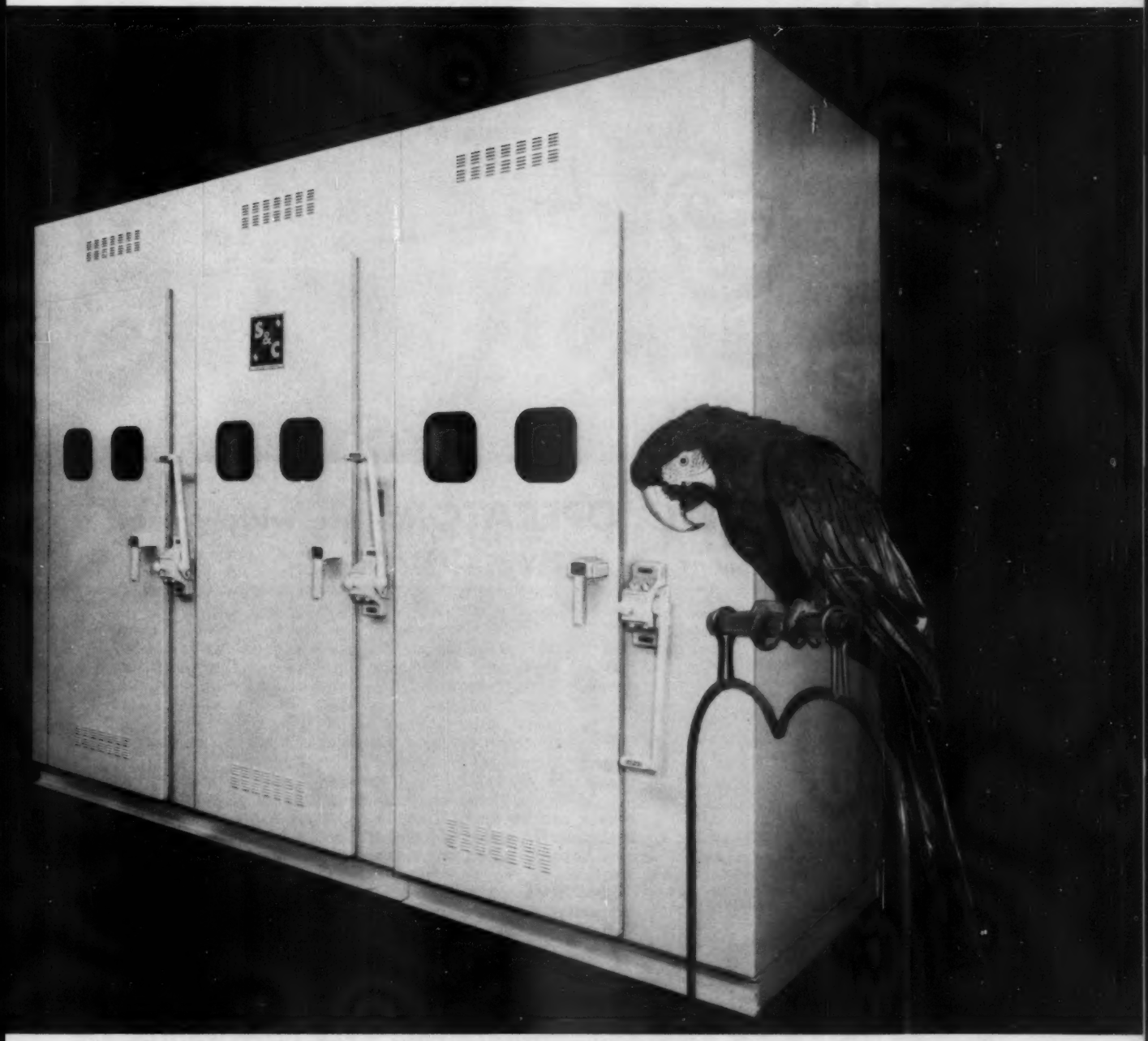
The economics all say, "Reclosing is for the birds." Why pay for a function you can't use?

Cut your high-voltage switchgear costs in half by specifying S&C Metalclad Switchgear for your 2.4 thru 14.4-kv switching centers, service entrances, substation primaries and secondaries. Get full-load switching to 1200 amperes and fault interrupting to 500,000 kva.

See the Yellow Pages (Electrical Equipment) for your nearest S&C sales engineer. Or write to:

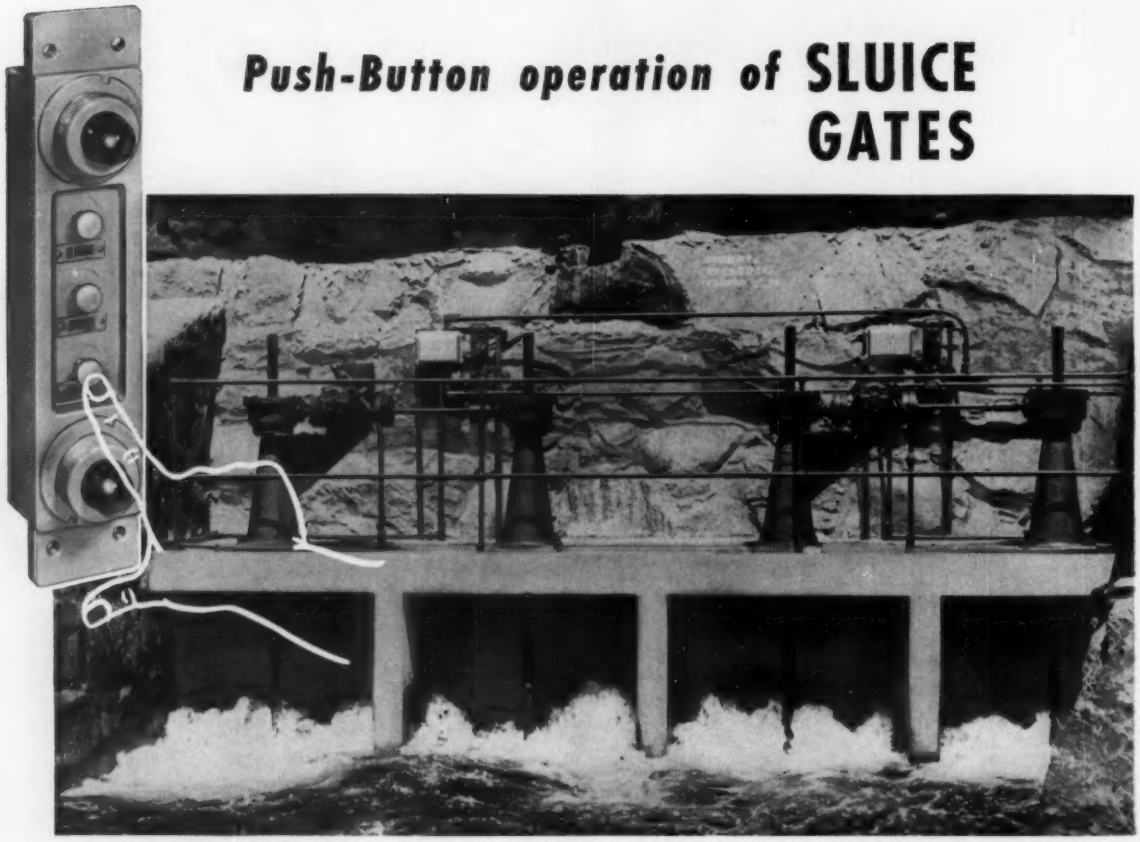
S&C Metalclad Switchgear meets all NEC requirements for fault-closing, short-circuit interruption. Performance proved by high-power testing at KEMA laboratories.

S&C ELECTRIC COMPANY
4436 Ravenswood Avenue • Chicago 40, Illinois
Specialists in High Voltage Circuit Interruption since 1911



The equipment is an S&C Metalclad Switchgear Assembly rated 13.8 kv, for a switching center.
The bird, a green-winged macaw, is an optional extra, obtainable at your local petshop.

Push-Button operation of SLUICE GATES



LimiTorque OPERATORS are widely used

Shown above are four 54" x 54" Sluice Gates operated by *two* LimiTorque Valve Operators at the Plant of the Connecticut Power Company . . . This unusual design and installation was the result of the cooperation of Rodney Hunt Machine Company and LimiTorque Engineers and proved to be economical and very satisfactory in service. Our sales and engineering staff is ready to aid you at any time with your valve operator problems.

LimiTorque automatically opens and closes valves and sluice gates from a conveniently located control point—eliminating guesswork and reducing labor costs. One man can operate any type of valve quickly and dependably in remote, inaccessible or hazardous locations; thus vital operating procedure can be handled easily by key personnel, safely and economically, and at the correct speed . . . And these controls may be mounted on any size valve, in almost any position or location.

LimiTorque controls can be field-mounted on existing valves—contact your valve manufacturer, or your nearest LimiTorque Sales-Engineering Office.

Write for complete Catalog L-550—and please use your Business Letterhead when requesting it.

THERE IS NO SUBSTITUTE FOR —

LimiTorque®

PHILADELPHIA GEAR CORPORATION

KING OF PRUSSIA (SUBURBAN PHILADELPHIA), PA.

Offices in all Principal Cities

PRECISION GEARS • INDUSTRIAL GEARS • SPEED REDUCERS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • King of Prussia, Penna.

The New Projects

Lighting Award for Detroit Hall

The lighting design for the exhibition areas of Cobo Hall, Detroit, Michigan, is slated to receive the 1961 annual design award given by the Michigan Section of the Illuminating Engineering Society. The design involved lighting for 300,000 square feet (three exhibit areas) on the main floor of the structure plus an additional 100,000 square feet of exhibit area on the first floor. Fred Lantz, of Giffels & Rossetti, Inc., Detroit, submitted the design for judging.

O'Hare Plant

A $4.36 million heating and refrigeration plant for the new O'Hare International Airport is in the initial construction stages. The mechanical equipment, housed in a steel framed, glass walled structure 320-ft long, 85-ft wide, and 40-ft high, includes four combination oil and gas fired boilers rated at 500,000 Btu per hour, and refrigeration equipment of 6000 tons capacity. It will be used to condition the new $18.3 million twin terminal buildings.

Naess and Murphy, Chicago architects and engineers, are the project designers. Malan Construction Corporation is the general contractor.

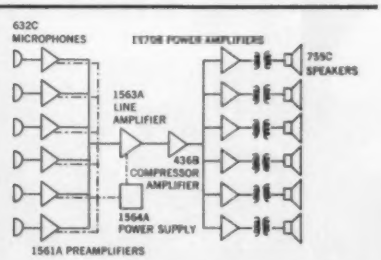
Engineer's Office Building

The J. E. Sirrine Company, engineers and architects, Greenville, South Carolina, has just awarded construction contracts for its own new office building. The $500,000 building will provide 32,500 square

Sound Solution to a Sound Problem:

ALTEC "DEPARTURE AND ARRIVAL" SOUND SYSTEM

SPECIFIED FOR
TULSA AIR TERMINAL
TULSA, OKLAHOMA



CASE HISTORY FILE 61-15: The Air Terminal required a distributed speaker system for announcing departures and arrivals. The system selected had to reach every waiting traveler clearly and without fail in all areas of the terminal, regardless of high noise levels generated by air craft.

SOUND PROBLEM: A distributed system consists of many speakers located throughout the area to be covered. Ideally—to reduce equipment, amplification, and installation costs—the system should provide complete coverage with the smallest number of speakers. Only a system of highest quality and efficiency can offer both effectiveness and economy.

SOUND SOLUTION BY ALTEC: A custom Altec component system achieved the ideal balance between requirements and cost. 350 wide-range Altec 755C "Pancake" Speakers are widely separated yet provide highest intelligibility through their unique 90° distribution pattern. Only six 175-watt Altec 1570B Amplifiers power this installation. Volume from each of the 350 speakers is automatically maintained at a pre-set level by a single Altec 436B Compressor Amplifier. Close-talking Altec Microphones are mounted on Altec desk stand/switch assemblies that include warning lights to advise each airline when the system is in use.

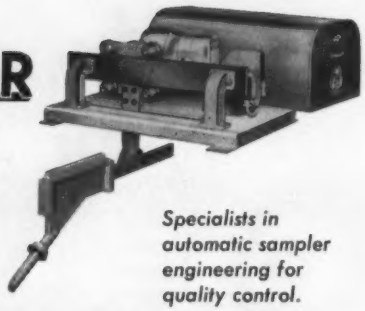
LET ALTEC HELP SOLVE YOUR SOUND PROBLEM: Find out about the solution Altec offers your sound problem, large or small, present or pending. Merely call the nearest Altec Sound Contractor (listed in your Yellow Pages) or write Dept. CE-7.

Electrical Engineer to Air Terminal: W. E. Short
Altec Sound Contractor: Ridley's, Inc., Tulsa, Oklahoma

© 1961 ALTEC LANSING CORPORATION

ALTEC LANSING CORPORATION
A Subsidiary of Ling-Temco Electronics, Inc.
1515 SOUTH MANCHESTER AVENUE, ANAHEIM, CALIFORNIA
NEW YORK • LOS ANGELES

DENVER



AUTOMATIC SAMPLERS

Specialists in automatic sampler engineering for quality control.

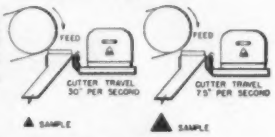
COMPLETE LINE OF SAMPLING AND SAMPLE PROCESSING EQUIPMENT

Wet, dry and dust-tight units. Simple, reliable, automatic. Units with cutter travel to 10′ and longer. New bottom-dump dry cutters (patent pending) for use where headroom is 10″ or less.

Dimensioned layout drawings and specifications sent on request.

NEW...30″/sec. Cutter Speed

reduces bulk of material taken — often eliminates cost of secondary sampling—without affecting reliability of sample.

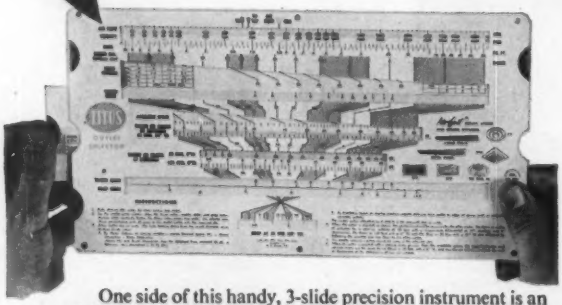


DENVER EQUIPMENT COMPANY

1400 17TH ST. • DENVER, COLORADO • CH 4-4466

NEW TITUS SLIDE RULE

Combination Outlet Selector & Air Flow Calculator for ENGINEERS & CONTRACTORS



One side of this handy, 3-slide precision instrument is an *OUTLET SELECTOR* to quickly determine outlet and size based on available space and noise criteria. Other side of rule is *FLOW CALCULATOR* to determine air flow rate for any diffuser or grille from velocity measurements in the field.

Developed by H. Straub, P.E., Director of Titus Research Laboratory. Based on over 5 years of research. 6″ x 11″ in size. *Furnished complete with 24-page Instruction and Information Booklet for $2.50.*

MAIL COUPON WITH $2.50 TODAY

TITUS MFG. CORP., WATERLOO, IOWA
Please send Titus Slide Rule complete with instruction booklet. Enclosed is my check for $2.50.

NAME_____

ADDRESS_____

CITY_____ STATE_____

feet of space for a staff of more than 125 people. The unique two-story building will occupy a three acre landscaped site with parking space for over 100 cars. The exterior design features exposed structural members and copious use of white glazed brick and glass for filler curtain walls.

St. Louis Hospital

Construction of St. John's Hospital, St. Louis, Missouri, is now under way on a 123-acre site — the fourth location of this institution since its founding in 1871. The project involves a main building, with

New St. John's Hospital and nurses' quarters, St. Louis.

immediate bed capacity of 420 and provisions for planned future expansion, and a six-story nurses' quarters and school with swimming pool. Future plans also call for the construction of a gymnasium-auditorium next to the nurses' quarters.

An unusual mechanical feature of the plant is the use of large (up to 10-in. diameter) copper tube for heating and air conditioning supply. Since all tubing connections are heliarc welded there is not a coupling employed in the design. Copper was chosen for its resistance to corrosion and resistance to mineral deposition from hard water.

Delaney, Sheldon & Associates, Inc. are the consulting engineers, Bernard MacMahon is the project architect, and the general contractors are C. Rallo Contracting and J. S. Alberici.

Indian Power Station

The Trombay thermal power station, another step in the burgeoning power development that is maturing under the second five-year plan of India, recently went into operation. The project was engineered for the Tata Power Company, Ltd. by Burns and Roe, New York consulting engineers. The completed plant will furnish 62,500 kw of power to the rapidly expanding industrial areas around the city of Bombay.

Space Needle

The symbol of the first World's Fair to be held in the United States in more than 20 years — a 600-ft steel and glass space needle — was dedicated recently at the Seattle, Washington, site of the 1962 World's Fair. Part of the dedication proceedings, attended by

quickly installed in old piping!

MUELLER® copper meter yokes

NEW compression couplings

...for steel or copper pipe

...with or without locking nut

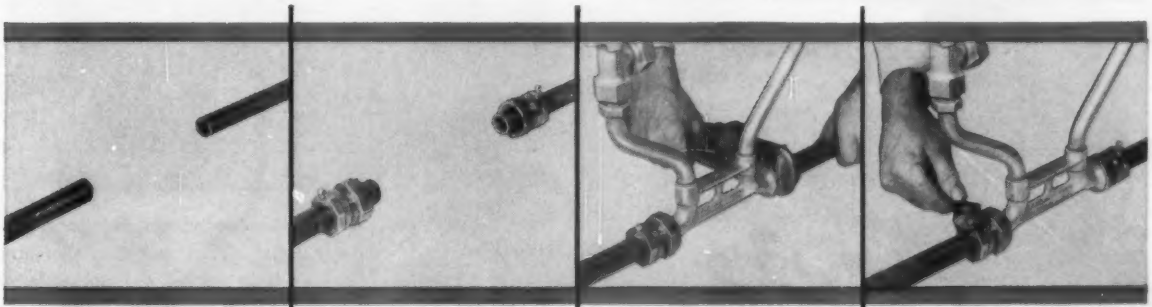
You can now install Mueller Copper Meter Yokes in any existing steel or copper piping in just a few minutes — and without cutting threads or sweating joints.

The simple step-by-step procedure for installing a yoke with Mueller's new Compression Couplings is shown below. Permanent, water-tight joints are quickly made even on rough and badly pitted pipe. Possible trouble is avoided because the piping does not have to be moved.

These new, time-saving couplings are now available for all Mueller Copper Meter Yokes with Multi-Purpose Ends. Regular compression nut or locking nut designs can be furnished for steel or copper pipe.

The locking nut type (shown) positively prevents any movement of the yoke on the pipe and insures continuous electrical bonding of the service piping.

Write for complete information and specifications on Mueller's Copper Meter Yokes.



1 Clean dirt, rust and scale from pipe and cut out a section just slightly longer than yoke (without coupling).

2 Remove all burrs from inside and outside of pipe and slip complete coupling over cleaned ends of pipe.

3 Align yoke between ends of pipe, slide couplings into place and tighten couplings securely onto yoke body.

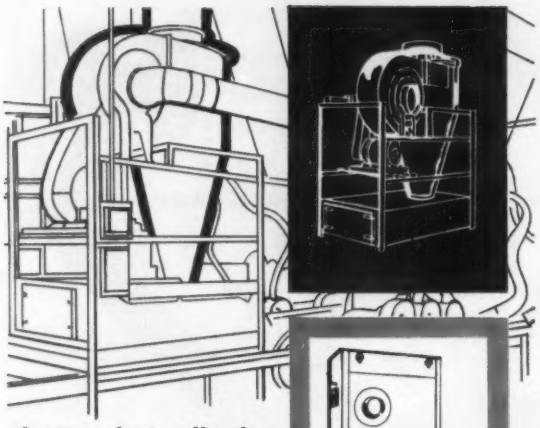
4 Tighten compression nuts on pipe and lock yoke in place by tightening locking set screw on clamp. Setting complete.

Copper Meter Yokes are just a portion of Mueller's complete line of quality-matched meter setting equipment.

MUELLER CO. Since 1857 SERVING the Water and Gas Industries QUALITY

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario.



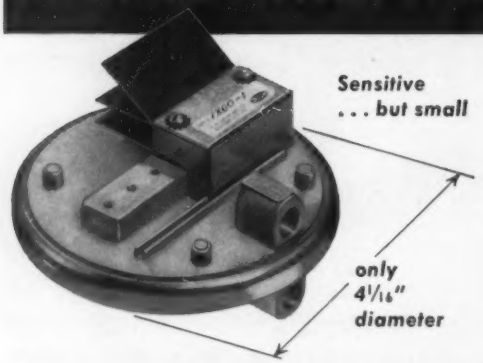
Custom dust collection
—with a standard unit . . .

Regardless of your dust collection problem, chances are there is a space-saving Dustkop model to fit the job. Aget, for years, has led the field in efficient, compact design and has developed more than 50 standard Dustkop collectors. Each is job-tailored to most grinding, buffing or finishing operations—as well as many other types of service. Write for illustrated brochure that helps select your tailored Dustkop unit.

Also a complete line of mist collectors

AGET MANUFACTURING COMPANY DUSTKOP
1379 EAST CHURCH ST., ADRIAN, MICHIGAN Stops Dust

New, Low Cost Dwyer Differential Pressure Switch



New Dwyer No. 1800 Series Switch is compact, low cost and highly sensitive to differential pressures in ranges from 0.15" to 80" water. Holds set point through various total pressures. Because of unusually small mass of moving parts, it is virtually unaffected by vibration. Use in any position. Pilot lights, explosion-proof housing, other optionals available. Request Bulletin E-40 for specs.

F. W. DWYER MFG. CO.
P. O. BOX 373-G • MICHIGAN CITY, INDIANA

state, city, and Fair officials, was the placing of some 2800 cubic yards of concrete in the 35-ft deep foundation forms of the structure. John Graham and Company, New York and Seattle, designers of the "needle," plan a revolving restaurant near the top, plus an observation deck topped by an ever-burning beacon. The needle-like tower structure will be supported by three pairs of structural steel struts anchored to the massive concrete foundation block.

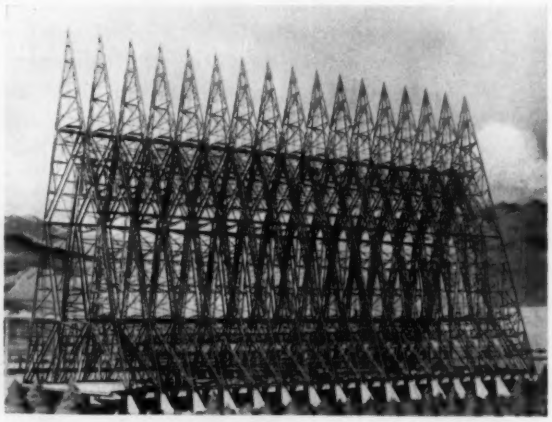
California Project Engineering

The Del Amo Estate Company has announced the selection of Engineering Service Corporation, Los Angeles, California, to render consulting engineering services in connection with the development of more than 1300 acres of industrially zoned land in Los Angeles County, and development of commercial land properties in Torrance, California.

Air Force Chapel

The chapel for the Air Force Academy, executed in tubular steel framework, has just been topped out. When completed, the chapel will provide, within one building complex, worship facilities for Protestant, Catholic, and Jewish students.

One hundred separate tetrahedrons of steel tubing are united to form 17 identical spire shapes at the peak of the building. The structure is intentionally



Air Force Chapel departs from conventional church design.

designed to bear no resemblance to any conventional ecclesiastical device — rather it seeks to create a mood of general inspiration.

The completed frame will receive a skin of 712 aluminum panels, and an additional 420 interior aluminum panels will form the ceiling of the Protestant chapel, which lies above a terrace level. On the terrace level, a roughly rectangular area will form the Catholic chapel area, and beyond this, a circular

How Johnston Verticals Are Used In An Expandable Water System

The country is growing so rapidly that new utilities must often be made completely "expandable."
Melbourne, Florida, a city of 20,000 twenty-five miles south of Cape Canaveral, faced up to this problem recently and built a spanking new water system capable of handling six times the immediate demand of 2,000,000 gallons per day, with only a small additional investment.

Pumps Are Truly Versatile

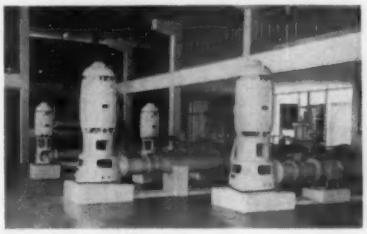
The Melbourne system takes water from the St. Johns River, gravity flows it 1500 feet from the intake structure to a raw water pump well on the shoreline, pumps it another 1400 feet to the plant for treatment, then stores it in tanks from which it flows into a 44 square mile distribution system.

Raw Water Supply

Four single stage Johnstons with weatherproof motors, mounted outdoors on a concrete slab, pump raw water from the intake well to the treatment plant. Two of the pumps with 15 hp. motors, deliver 2 mgd.; the others with 30 hp., have twice the capacity. All operate at 25 foot heads.

Water Treatment and Distribution

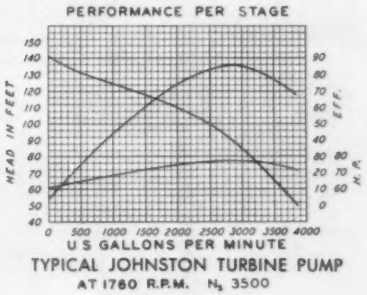
Five Johnstons are used for water treatment and distribution, all located on the floor of the pump room. Four are high service units which lift the water to the supply tanks. Two 3 stage 60 hp. units deliver 2 mgd. each at 140 feet total discharge head when operating singly or 160 feet when in parallel.



The other two high service pumps, each 200 hp., deliver 4 mgd. each with a total head of 210 feet singly and 256 in parallel. The fifth unit is a 100 hp. single stage pump which is used to wash the water back through the filter to remove debris. This pump delivers 6750 gpm through the filter at 37 feet head.

Why These Pumps Are So Versatile

These Johnstons perform well under all operating conditions and are designed to handle all types of liquids including several kinds of chemicals and filtering agents. All pumps were made so that the entire column assembly, including the suction bell, can be lifted vertically when the discharge heads are unbolted. Steep-head capacity curve and flat horsepower requirements (see Figure 3) make them economical to operate at all speeds. Capacities can be further increased merely by adding more stages. The pumps are always primed and require a minimum of floor space.



TYPICAL JOHNSTON TURBINE PUMP
AT 1760 R.P.M. N_s 3500

Figure 3

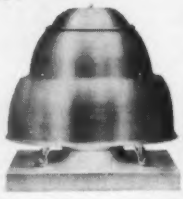
Johnstons have been used by forward looking utilities for over half a century because of versatility, dependable operating characteristics and sound economy. For information on applications, operating data or construction details, contact the main plant, any branch, or nearest distributor. A qualified field engineer will be available for consultation.

JOHNSTON PUMP COMPANY
3272 E. Foothill Blvd., Pasadena, Calif.
Branches:
Pecos, Texas; Roswell, N.M.; Hastings, Neb.; Idaho Falls, Idaho; New York, N.Y.; Atlanta, Ga.; San Francisco, Calif.

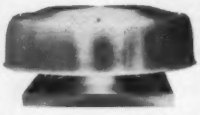
NEW! GREENHECK
Air Movers

ADDITIONS TO THE GREENHECK LINE OF AIR MOVERS FOR 1961

"C" SERIES DIRECT DRIVE CENTRIFUGAL SPUN ALUMINUM EXHAUSTER
A roof exhauster that has its motor out of the air stream and the unit cradled on resilient mounts . . . high efficiency wheel design with overlapping inlet cone providing high exhausting capacities . . . available in sizes from 7" to 18".



LOW SILHOUETTE CENTRIFUGAL BELTED POWER ROOF EXHAUSTER
Motor and Drive are completely isolated from the air stream in this new GREENHECK LB-LINE . . . enclosed in a one piece SPUN ALUMINUM HOUSING . . . symmetrical shape lends eye appeal to any installation. Available in a size range from 16" to 48".



SIDEWALL AXIAL BELTED FAN — SAB-LINE
The design of the fan panel in the SAB line makes it possible to be used either as SUPPLY or EXHAUST by reversing the blade. Available in a size range from 24" to 48".

Write for latest catalog, complete details and specifications.

GREENHECK FAN & VENTILATOR CORP.
SCHOFIELD • WISCONSIN

Relax and Play on Mobile Bay

Grand Hotel
POINT CLEAR, ALABAMA

A distinguished resort that's as popular for corporation meetings as it is with honeymooners and vacationing families! Occupying Point Clear on Mobile Bay, Grand Hotel is an internationally-famous pleasure-land for the discriminating. Superb cuisine and luxurious comfort in the intimate club atmosphere of a 350-acre estate. 100% air conditioned. American Plan.

Home of Lakewood Golf Club, scene of All-Star Golf matches (ABC) and annual Seniors' Tournament.

James P. Pope, Resident Manager
GRAND HOTEL — Point Clear, Alabama
Murray Stevenson, Vice President
Owned and operated by Southern Industries Corporation, Mobile, Ala.

shaped Jewish worship center will be provided. The base cost of this project (without paving and landscaping) exceeds $3 million. Skidmore, Owings and Merrill, architects and engineers, did the design.

Hydrazine Plant

Anhydrous hydrazine, a rocket fuel, will be produced in record quantities at the Air Force plant just completed in Saltville, Virginia. Reported to be the world's largest, this plant cost $15 million, and due to optimum automation, it is scheduled for 24-hour operation with a complement of 100 men. The facility will be operated by the Olin Mathieson Chemical Corporation for the Air Force. The project was completed in nine months by the engineer-contractor, Arthur G. McKee and Company, Cleveland.

New Industrial Plant

Ground was broken recently for a new $1.2 million manufacturing plant for John J. Nesbitt, Inc., Philadelphia, Pennsylvania. The building, designed by the Ballinger Company, will cover 106,000 square feet of floor space. It will supplement an existing 50,000 sq ft building on the 11 acre site. The plant will manufacture air conditioning and heating equipment.

Ketchikan Hydroelectric Project

The firm of R. W. Beck and Associates, analytical and consulting engineers, Seattle, Washington, has been selected to plan the Lake Whitman hydroelectric project for the City of Ketchikan, Alaska. The project encompasses new penstock construction, the repair of an existing dam, the construction of a power house, and installation of a 2000-kw power unit. In In addition, provision for a future 2000-kw power unit is to be designed into the power house. Project planners expect to complete design by late 1961 so that bids may be taken in early 1962. This is the third job that this firm has done for the City of Ketchikan.

Two-Mile Finger Pier

A $40 million, two-mile-long ship terminal is to be built just north of the U. S. Naval Base, at Bayonne, New Jersey. The pier is to be a 600-ft wide, filled-in finger type structure with 6860 feet of the length extending into the upper bay and 3500 feet extending inland. Ship berthing along the full length of the south side of the pier will accommodate 2.5 million tons of shipping annually, and the facility will provide employment for 3500 people.

The entire project involves the transformation of 217 acres of tideland into one of the most modern facilities of its type. Since the pier projects inland, it can be used effectively for staging and distribution of commodities. The project was engineered by Frederic R. Harris, Inc., in collaboration with Charles S. Christopher, of Intransit Terminals. ▲▲

More seeing comfort by design . . .

NEVER BEFORE, SO MUCH SEEING COMFORT AT SO LITTLE COST *in a Plastic-enclosed Fluorescent Fixture for Surface Mounting*

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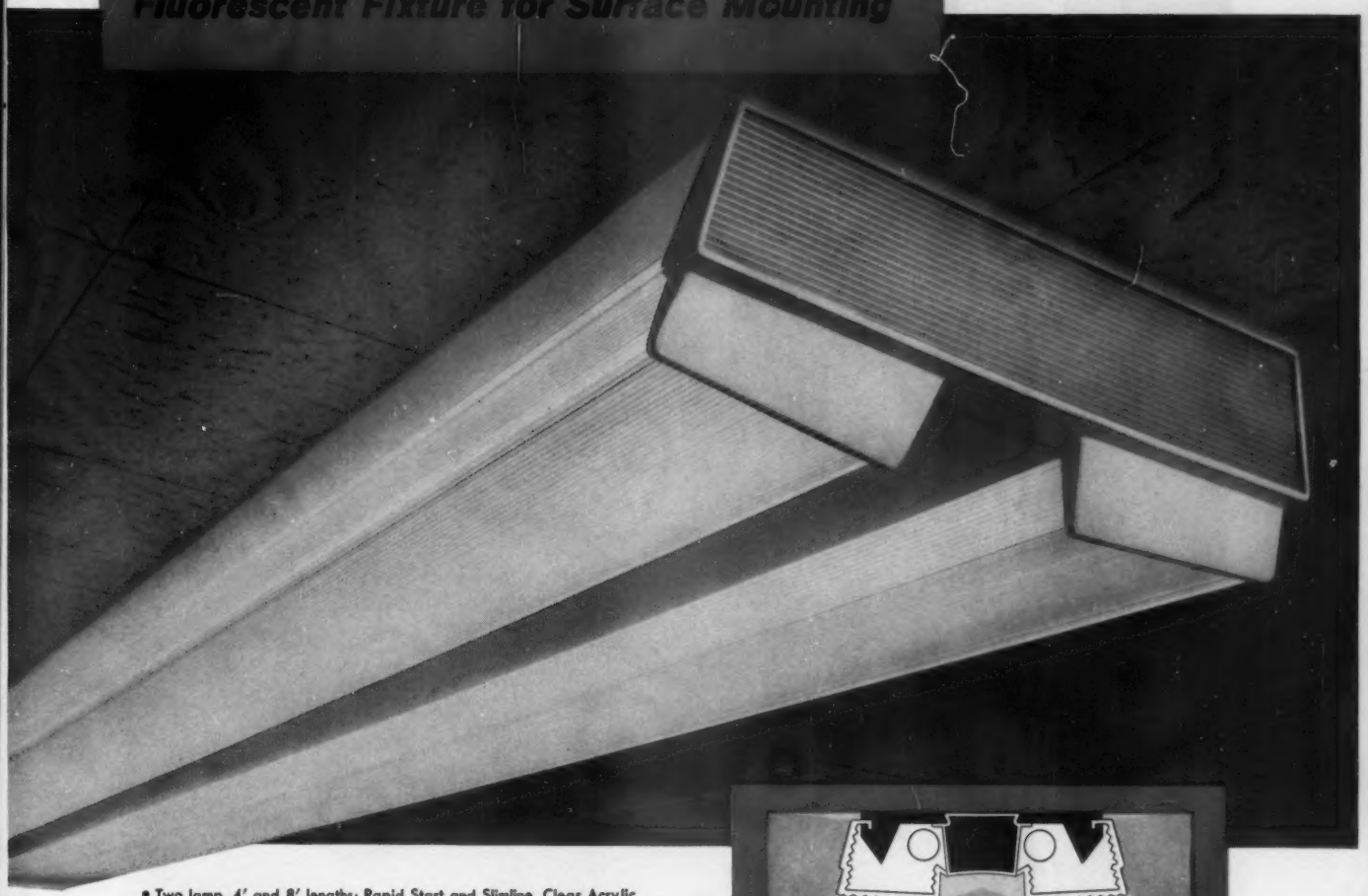
LIGHTING by miller



- Two lamp, 4′ and 8′ lengths; Rapid Start and Slimline. Clear Acrylic or light stable Polystyrene lenses. 13⅛″ width.
- Self Hinging Plastic Enclosure for Each Lamp supported on both edges by continuous flanges in channel—Easy to Maintain—No Sag.
- Cooler Lamp and Ballast Operation—each lamp has its individual compartment widely separated by exposed metal channel which acts as a heat dissipator.

This altogether new and different looking fixture is a precision lighting tool, optically designed for optimum *seeing comfort* and economy . . . a performance feature we call Opticomfort. Duplex-a-lite controls and evenly distributes the right amount of the right kind of light where it's needed most . . . puts more usable light on the work or merchandise—less in the eyes. It is especially suitable for schools, offices, public buildings and stores . . . wherever there's a need for *seeing comfort* over prolonged periods of time.

A truly unique combination of fresh, trim appearance and *seeing comfort* at a *modest* price . . . a natural for on-the-ceiling mounting in newer buildings where ceilings are low.

For complete information, write Dept. 661 S, or contact your Miller Representative.

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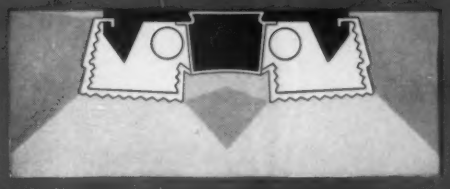

*Opticomfort** BY DESIGN

Another Miller First! Twin compartments separate and house each of Duplex-a-lite's two lamps in a unique manner that enables the optically designed, prismatic lenses to limit and control most of the light within the highly critical 45°-90° viewing zone. This assures optimum seeing comfort, or Opticomfort. Ceiling and center channel cover are softly illuminated. Enclosures of rigid plastic require no shadow-causing interior framework.

*Trademark Patent Pending

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new Federal specification

Federal Specification INT. SSP-00385 covers Southern Pipe STEELCOR CEMCOTE Water Pipe . . . cement-mortar lined and reinforced cement-mortar coated welded steel pressure pipe from 4 to 42 inches in diameter for use in water transmission, distribution, and feeder pipelines. New Southern Pipe Technical Bulletin 100 covers this Federal Specification

Technical Bulletin 100 Includes:

- complete federal specification INT. SSP-00385
- Design Tables covering water pressure classes 100 to 400
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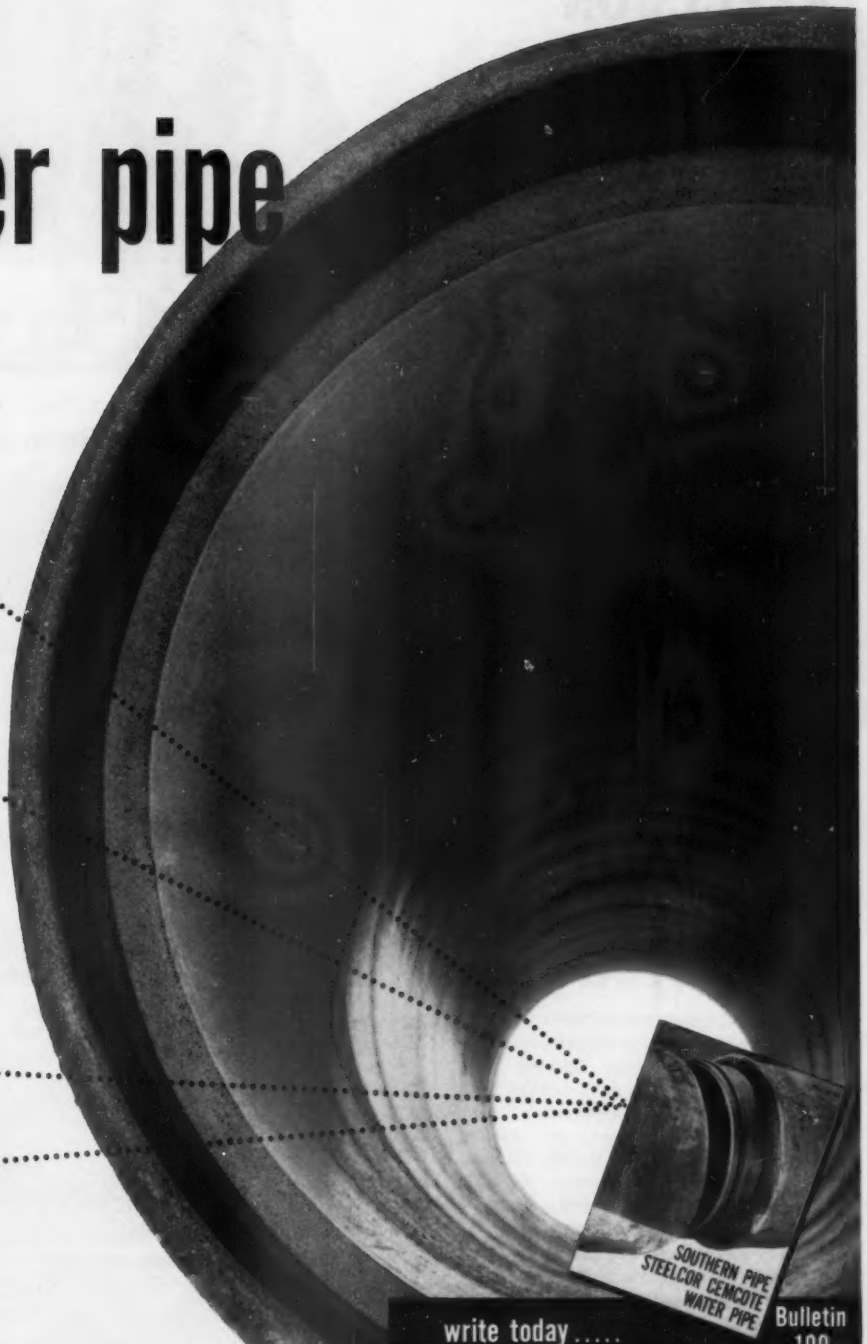

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Men and Firms

Leif J. Sverdrup, president and director of the engineering firm of Sverdrup & Parcel, Inc., St. Louis, Missouri, will receive the 1961 National Society of Professional Engineers award for outstanding service to the engineering profession at the Society's annual meeting in Seattle, this month. The award cites Sverdrup for "his acumen, sound judgment, and ability as an engineer executive; his patriotism, valor, and meritorious service to his country as an engineer soldier; his constructive, distinguished, and unselfish public service to his fellow man as an engineer citizen; and his talents, competence, and leadership as a professional engineer."

SVERDRUP COUNSELMAN

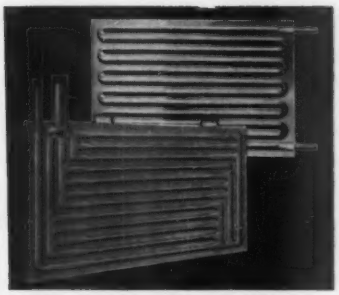
Theodore B. Counselman, consulting metallurgical engineer and secretary-treasurer of Behre, Dolbear and Company, of New York City, has been awarded Columbia University's Alumni Medal for "service of exceptional merit" to the University. Counselman is a 1910 graduate of Columbia.

At its recent annual meeting, in Rapid City, the Consulting Engineers Association of South Dakota elected the following new officers: Calvin Vaudrey, president and alternate director to Consulting Engineers Council; Fred Brady, vice president; Waldo Scott, secretary-treasurer; John Reese, director to CEC; and Delbert Hedin, James Bell, Donald Flahart, and Frank Brady, directors.

John Clarkeson, president, The Clarkeson Engineering Company, Boston, has been elected a member of the American Institute of Consulting Engineers.

A new engineering firm, Lovelace, Lawrence and Company, Inc., has been established in Toledo, Ohio. Giles E. Lovelace, formerly associated with Brisch Inc., of Toledo and London, England, is president of the new firm. Senior partners are John R. Kershaw and Brian J. M. Lawrence. The new firm offers consulting and design service on industrial classification and coding, standardization and simplification, and information storage and retrieval. Offices are located at 1015 Spitzer Building.

Among the 14 members of the American Institute of Electrical engineers elevated to the grade of Fellow for contributions to the profession were: Carl E. Asbury, chief electrical engineer, Common-



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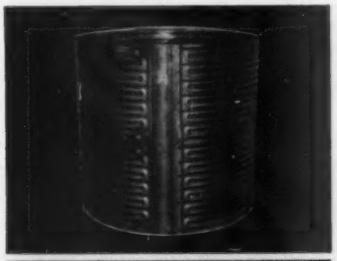

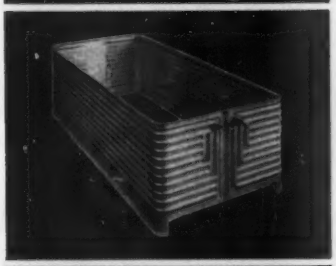

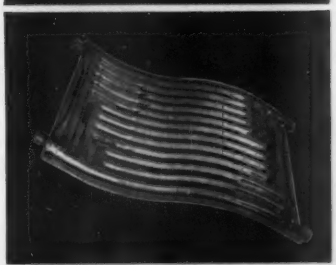

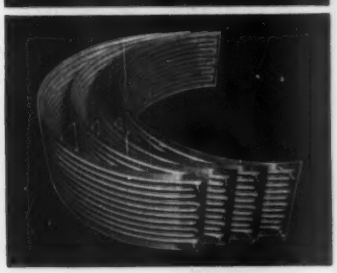

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Now you can apply the engineering, installation, operational and maintenance advantages of PLATECOIL to more tank and process heating and cooling problems than ever before. Standard units with exclusive "MULTI-ZONE" pass design for faster heat-up and temperature recovery or serpentine pass arrangement satisfy many requirements. These "standard" styles, available in a wide variety of sizes can be factory-fabricated into banks to fit the application. PLATECOIL can be formed and rolled to specified diameters or even fabricated to form tank walls.

PLATECOIL provides a "packaged" answer to many heat transfer problems, avoiding costly engineering and fabricating of pipe coils. Units are easy to install and maintain—with simple connections, light weight, and streamlined surfaces. High heat transfer capacity permits compact, space-saving units.

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wealth Associates, Inc., Jackson, Michigan, "for contributions to the field of power engineering and to national and international standards;" and Charles W. Maloney, chief engineer, Stone and Webster Engineering Corporation, Boston, "for contributions to the design of electric generating stations and major system frequency conversion."

J. C. Triolo and Associates is a new consulting engineering firm established at 1100 Champa Street, Denver, Colorado. Headed by John C. Triolo as president and owner, the new firm offers specialized service in electrical and mechanical design.

C. Maxwell Stanley, senior partner and general manager of Stanley Engineering Company, Muscatine, Iowa, has announced that the firm has been incorporated, with no change in name. Directors of the firm are Max Stanley, Art Stanley, and San Fosholt, former partners, and Roy Vanek and Frank Edwards, former associates. Eight key employees of the firm are being brought into the corporation as owners: E. H. Breckenfelder, supervising engineer; A. H. Dunton, in charge of preparing engineering reports; A. O. Garvik, supervising engineer; H. L. Godeke, chief mechanical engineer; E. C. Lister, electrical engineer; M. W. Sedgley, in charge of supervision of construction projects; R. H. Stanley, now on special assignment in West Africa; and B. L. Sturdevant, in charge of design engineering.

Herbert E. Hudson Jr., partner in the firm of Hazen & Sawyer, New York, has been named to head a new standing committee on education for the American Water Works Association. The committee on education will take over the development and expansion of AWWA's management education program, formerly part of the water utility advancement program. It also will be responsible for all other phases of AWWA education activities.

HUDSON NISHKIAN

M. A. Nishkian, consulting engineer, Long Beach, California, has been given the "Citizen of the Year" award by the Exchange Club of Long Beach. The presentation was made at the Club's recent annual Citizen of the Year luncheon where several past recipients of the honor and numerous dignitaries were present.

Fred C. Limbert, partner in Samborn, Steketee, Otis and Evans,

AUTOCALL FIRE ALARM SYSTEM SAFEGUARDS NEW BANK OF GEORGIA BUILDING

This modern new 31-story commercial building in the heart of Atlanta is unique. In addition to being the tallest building in the southeast, it is the highest reinforced concrete structure in the U.S.A.

Equally modern is its fire protection system. 61 strategically located fire alarm stations combine with an Autocall DNS system with Annunciator Panel for instant and continuous alarm. This control panel visually shows the floor of the originating signal for immediate fire-fighting action.

This completely supervised system also sounds a trouble bell if an open or grounded condition should occur.

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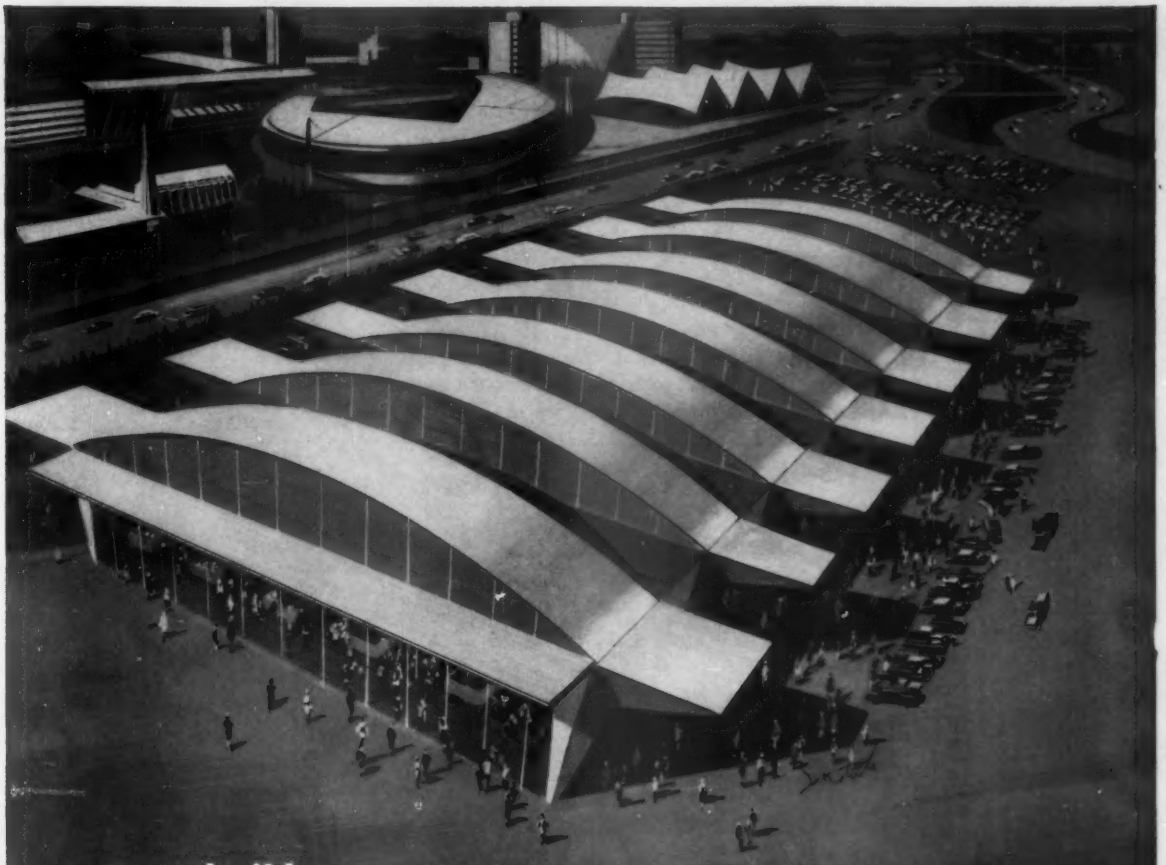

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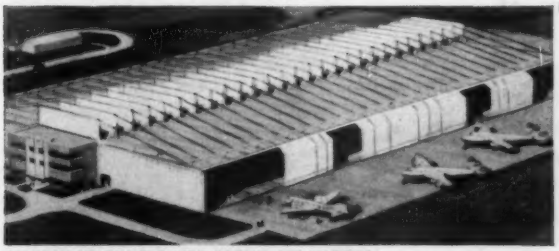
THE SHOPPING CENTER OF THE FUTURE—NOW!

In this shopping center of the future, the suspended roof would leave every square foot of interior space completely unobstructed. An artist's conception, yes — but this is no unattainable "dream building." Modern suspended roof techniques pioneered by Roebling make it practical and economical *now*.

Consider the down-to-earth advantages. Floor space for supports would become paying space instead. Merchandise would be handled, displayed and sold with new ease and efficiency. Customer traffic would move faster with fewer obstructions. Add low first cost and the prospect becomes even more alluring!

Suspended roofs are paying off handsomely in many types of buildings — plants, gymnasiums, airline terminals and hangars, auditoriums, stadiums and others.

Roebling's great experience with steel in tension enables it to take an active leadership in the suspended roof field. This experience is available to you. For information please call or write Roebling's Bridge Division, Trenton 2, New Jersey.



SUSPENSION ROOFS NOW AT WORK . . .
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engineers and architects, Toledo, Ohio, has been elected chairman of the Functional Group of the Consulting Engineers of Ohio.

The Austin Company, Cleveland, Ohio, has announced the formation of two new firms in Australia and Argentina:

Austin-Anderson (Australia) Pty. Ltd., with headquarters in Sydney and an office in Melbourne, will have as its managing director, A. J. Anderson, of A. J. Anderson Pty. Ltd., industrial building specialists. Charles J. Groux, associated with Austin for 34 years, will serve as chairman of directors of Austin-Anderson.

Cyril F. Prideaux, formerly president of Austin's Brazilian firm, is executive vice president and general manager of Austin-Graziani, S. A., Buenos Aires.

Clarence A. Dauber has been appointed to head the thermal power engineering activities of Chas. T. Main, Inc., consulting engineers, of Boston. Dauber formerly was director of the civil and mechanical division for The Cleveland Electric Illuminating Company.

DAUBER HEMSARTH

John H. Hemsarth has been appointed general manager, power division of the Fluor Corporation, Ltd., Los Angeles. Hemsarth formerly was supervising engineer at United Engineers and Constructors, Inc., Philadelphia, Pennsylvania.

At their recent annual meeting, stockholders of Albert Kahn Associated Architects and Engineers, Inc., Detroit, elected the following directors: George H. Miehls, Sol King, Sheldon Marston, R. E. Linton, V. C. Wagner, G. S. Whittaker, and Paul G. Fleck. All are incumbent directors with the exception of Fleck, who was elected to the seven-man board for the first time. Officers elected by the board for the coming year are: George H. Miehls, chairman and treasurer; Sol King, president; Sheldon Marston, executive vice president; R. E. Linton, V. C. Wagner, G. S. Whittaker, and Paul G. Fleck, vice presidents; and Louis Menk, secretary.

Harold D. Hauf, Dean of the School of Architecture at Rensselaer Polytechnic Institute, Troy, New York, and formerly chairman of the Department of Architecture at Yale University, has been named vice president in charge of design and planning for Charles Luckman Associates, planning-architecture-engineering firm of Los Angeles and New York. ▲▲

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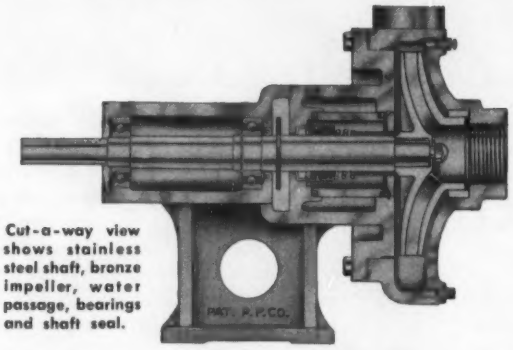

Cut-a-way view shows stainless steel shaft, bronze impeller, water passage, bearings and shaft seal.

Designed to meet the critical requirements of heating systems using hot water circulation.

Patented design principle incorporates built-in heat exchanger that keeps mechanical shaft seal and pedestal ball bearings C-O-O-L, while circulating high temperature water through hot water heating system.

Bulletin 1400.8 describes construction and operation. Send for your copy.

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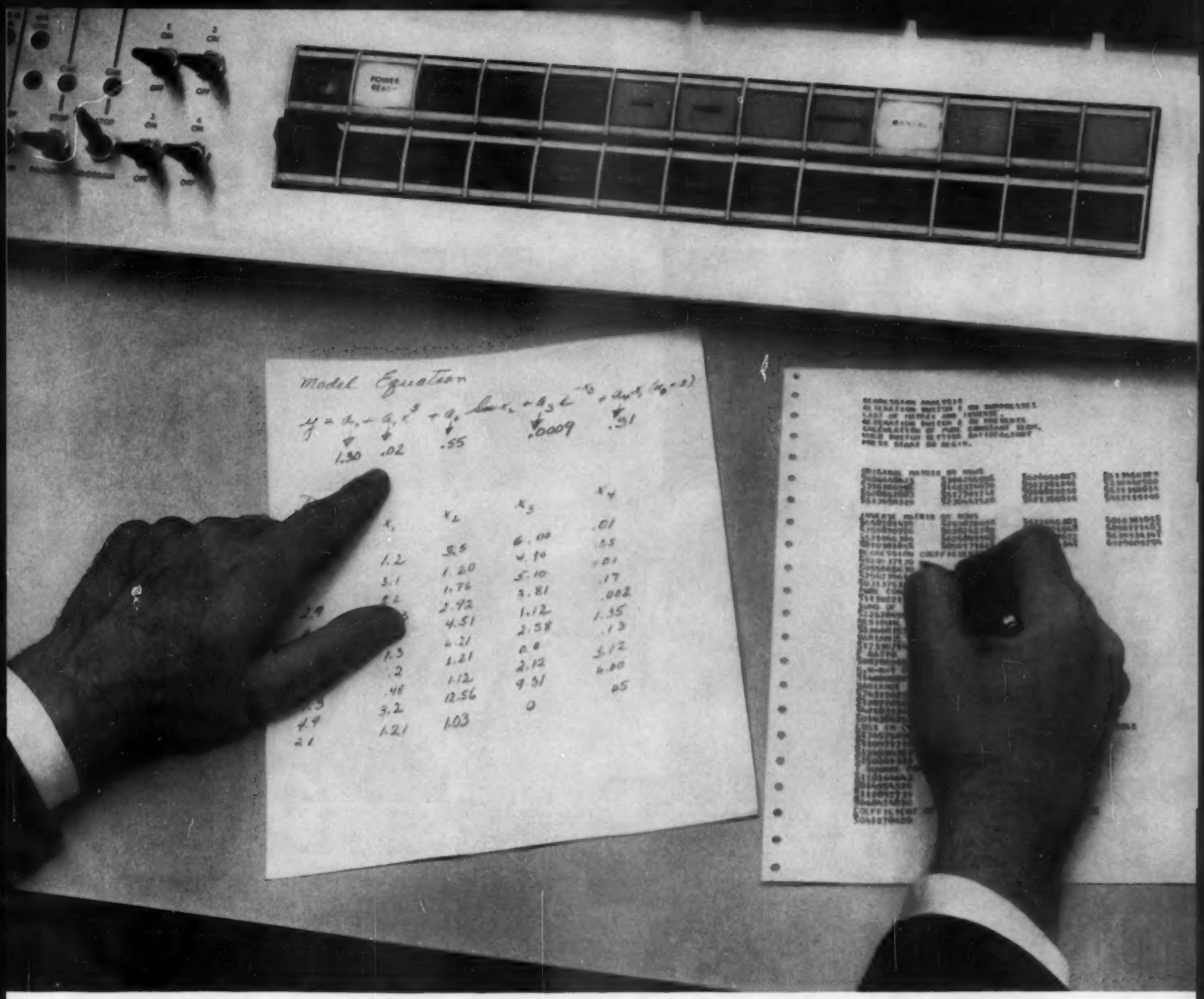

Want to find the coefficients? It's easy with the new Regression Analysis program for the IBM 1620

Here's another program offered free-of-charge to users of the IBM 1620 Data Processing System. It gives you the kind of results you might expect only from a much more expensive computer. But users of the 1620 know that its low rental cost is deceptive. The 1620 packs *more computing power per cubic inch* than any other computer in its size range.

The Regression Analysis program is a good example. Suppose you want a fit for production purposes. If you employ more than two variables you probably have difficulty visualizing the representation of your data. If linearity is not the case, you must often guess blindly at a polynomial of high degree, accept or reject the fit with something approaching a sixth sense, and either try again or settle for the results you have.

The new Regression Analysis program lets you handle expressions containing up to *24 variables*. If you have the even more complicated task of handling many dependent variables, the program will generate regression coefficients with a maximum number of dependent variables not exceeding one-half the number of independent variables.

This program will also fit non-linear functions and hyper-surfaces. Compare this performance with that of any other computer in the 1620's price range.

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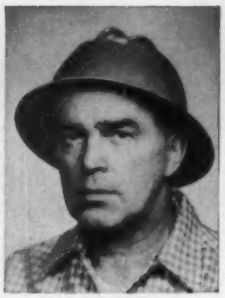

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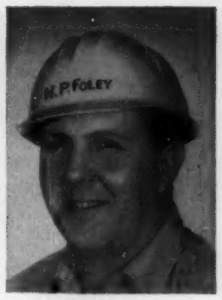

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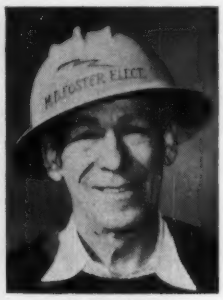

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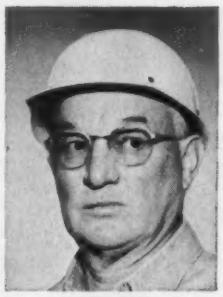

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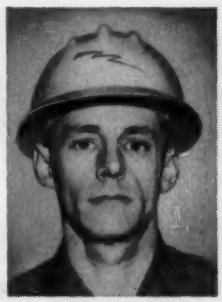

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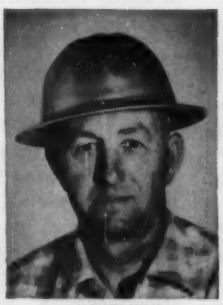

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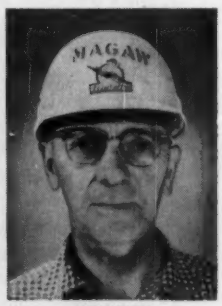

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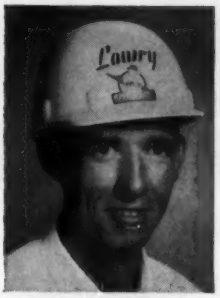

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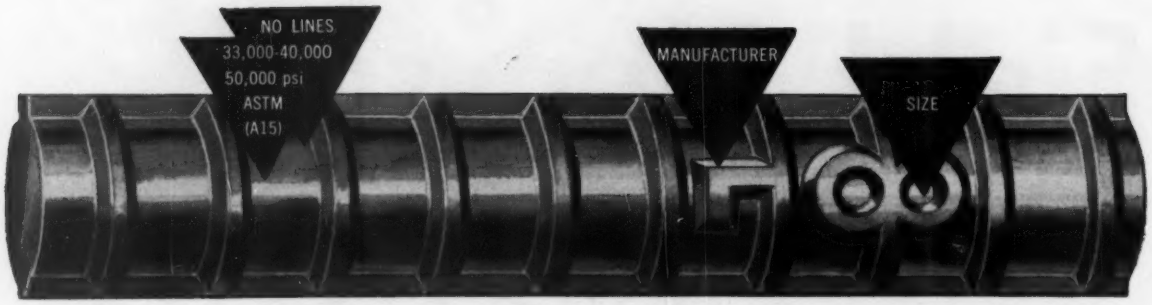

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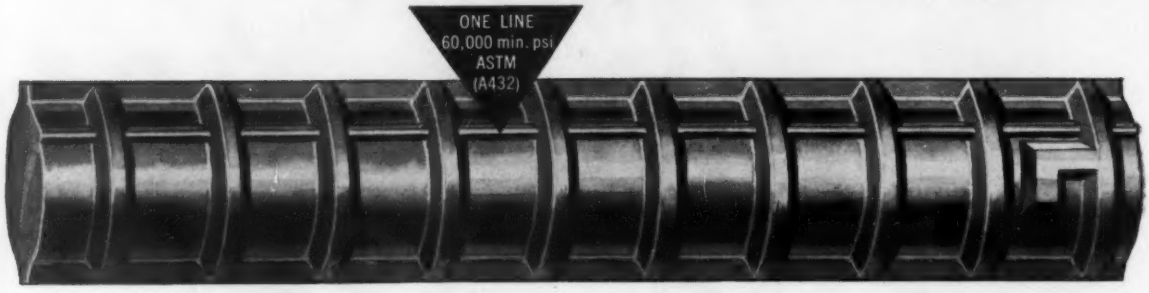

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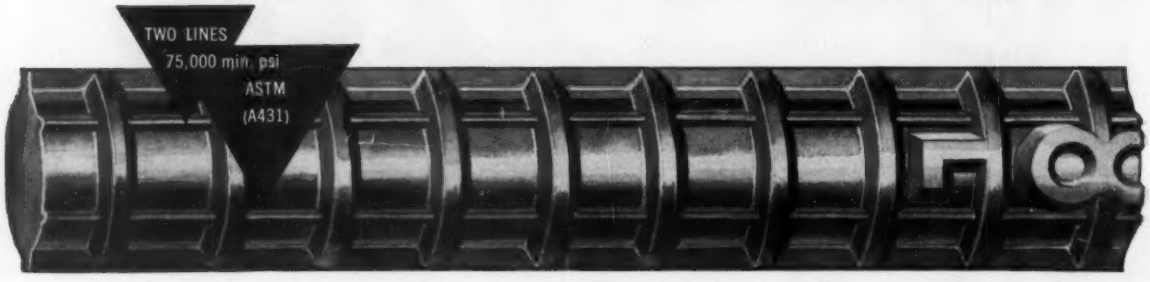

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Parallel Reading for Consulting Engineers

The Fifteen Wonders of the World, by Rene Poirier; Random House, New York, N. Y.; $5.95.

According to Rene Poirier, the 15 wonders of the world include the Tower of Babel, the Pyramids, the Great Wall of China, the Roman Roads, the Palace of Versailles, the Transatlantic Cable, the American Transcontinental Railway, the London Underground, the Tay and Forth Bridges, the Eiffel Tower, the Panama Canal, the Simplon Tunnel, the Reclaiming of the Zuyder Zee, the Volga and Tennessee Hydroelectric Dams, and the Oak Ridge Atomic Power Project. It is interesting to note that in Poirier's eyes, all these wonders are wonders of civil engineering. Even his discussion of the Oak Ridge project is more concerned with actual construction of the physical plant than with the wonder of atomic power.

It takes Poirier almost half of his book to travel from the Tower of Babel through the Palace of Versailles. This is probably as it should be, for most of us are not well versed on the engineering talent which went into these ancient wonders. In fact, the completion of Versailles marked the end of an era of primitive engineering which made up for its lack of engineering knowledge with a lavish and brutal expenditure of man power. There was a little of this displayed by the French in their early efforts in Panama, but it was not on the grand scale displayed by Louis XIV in his lifetime project at Versailles. By the time the Transatlantic Cable was laid in 1858, workers on large construction projects were given reasonably humane treatment, and the work proceeded on the basis of a significant body of engineering knowledge.

Engineers will find this volume of particular interest, and its translation from the French by Margaret Crosland has in no way affected its readability. *The Fifteen Wonders of the World* is a valuable contribution to the history of engineering.

•

A Nation of Sheep, by William J. Lederer; W. W. Norton & Company, Inc., New York; $3.75.

William Lederer, coauthor of *The Ugly American*, apparently has written this new book for those who failed to read *The Ugly American* or who did not understand it. At any rate, it is factual and easy to read, and the implication of the title is driven home solidly. It is a good book for complacent Americans, showing clearly that we are being outwitted both by our friends, "the nations on our foreign aid list," and by our enemies, the Communists.

Lederer sites Laos, Thailand, Taiwan, and Korea as examples of areas where the cry "Communists" has resulted in an immediate flood of American dollars. Often these dollars have had no place to go, and merely have served to upset an already ill-balanced economy. By knowing the language and the people, the Communists have made inroads without the need for a mili-

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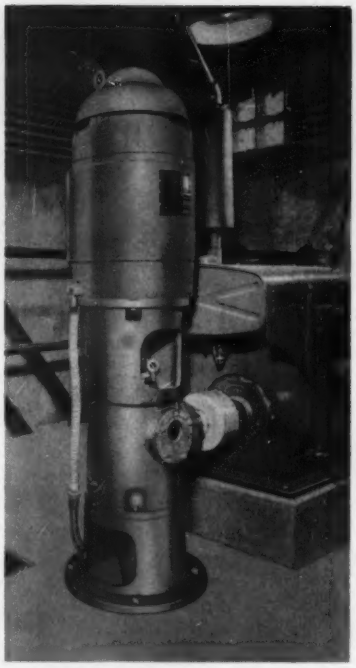

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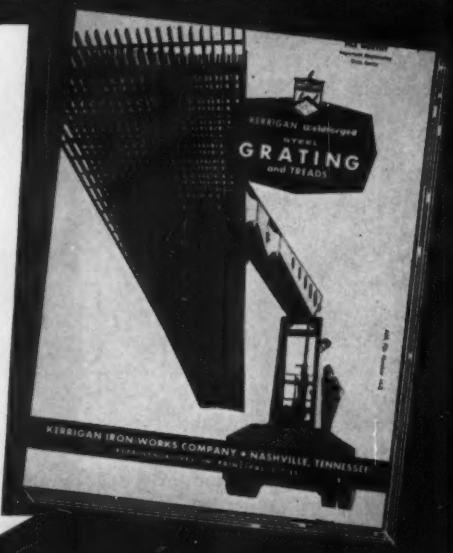

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tary offensive. Meanwhile, says Lederer, we back the wrong people when we place all our bets on such as Syngman Rhee and Chiang Kai-shek. These men may look good to our diplomats, but to their own people and to the rest of the world they are little more than bandits.

Having made his point – that we Americans have been cuckolded in our foreign aid program – Lederer goes on to point out how something can be done about it. This is really the important part of the book, and it is hoped that readers will give it their full attention – and then act.

•

Fares, Please!, by John Anderson Miller; Dover Publications, New York, N. Y.; $1.50.

If you are old enough to have flattened nails under the neighborhood trolley, you will enjoy this book. In fact, you will enjoy it even if you are not that old. It is an interesting history of mass transportation, written in a style for the layman, but with just enough technical background to pique the interest of the engineer. It begins with Abraham Brower's "Accommodation," which first operated as a horse drawn coach up and down Broadway in 1827. It ends with this prediction:

"American cities may never reach the condition that prevailed 2000 years ago in Rome when the private vehicles of all but the most important people were banned from the congested streets in the center of the city, but neither are they likely to reach a condition when they can dispense with the service of the common carrier transportation vehicle, and the old cry of 'Fares, please!', which has been a characteristic feature of transit service since its earliest days, and will continue to echo down the years."

It may be of passing interest to those who are struggling with today's problems of mass transporta-

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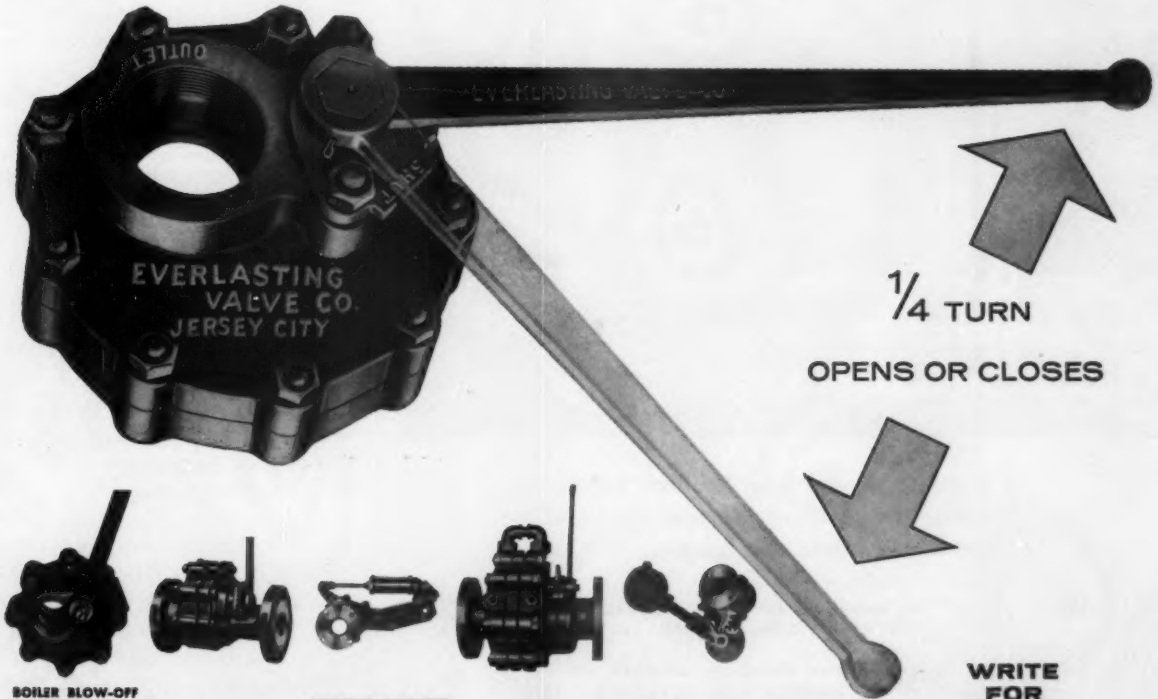

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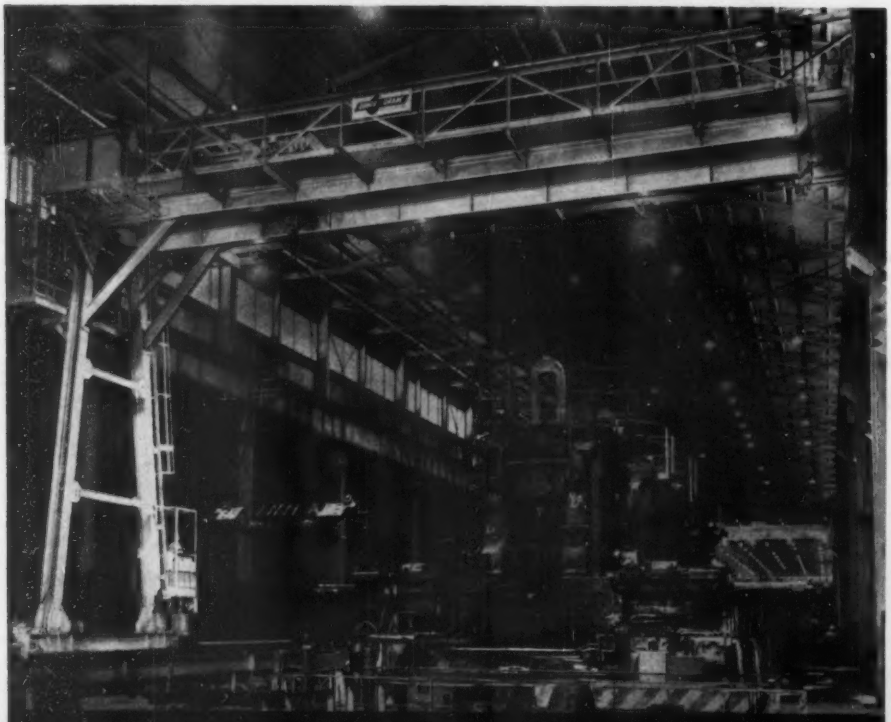

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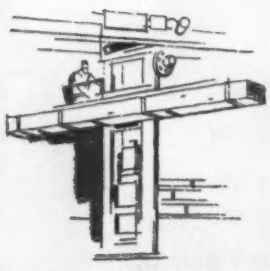

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•

New Technical Books

ENGINEERING DRAWING AND GEOMETRY, (second edition), by Randolph Hoelscher and Clifford Springer; John Wiley & Sons, Inc., New York; $9.00. Since the first edition of this book came out in 1956, the text has become almost a classic in its field. It is one of the largest and easiest to read of all the drawing texts, and features the use of all the latest American drawing and engineering standards. In addition to its other virtues, the book is well illustrated.

CIRCUIT ANALYSIS, by Elias M. Sabbach; The Ronald Press, New York; $8.75. Based on courses in electrical engineering taught at Purdue, this text treats the theory of electrical circuits from the elementary notions of electric field. The work is organized into short chapters, and is well-illustrated.

BOOLEAN ALGEBRA AND ITS APPLICATIONS, J. Eldon Whitesitt; Addison-Wesley, Reading, Massachusetts; $6.75. This introductory treatment of Boolean algebra is intended for students with a limited knowledge of formal mathematics. It covers the algebra of sets, symbolic logic, and circuits, particularly computer circuits. ▲▲

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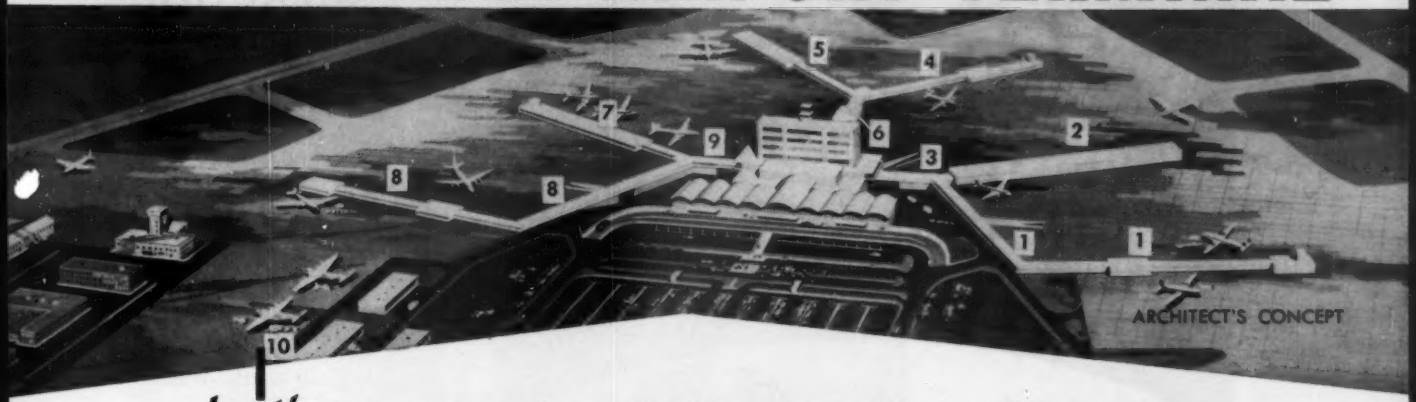

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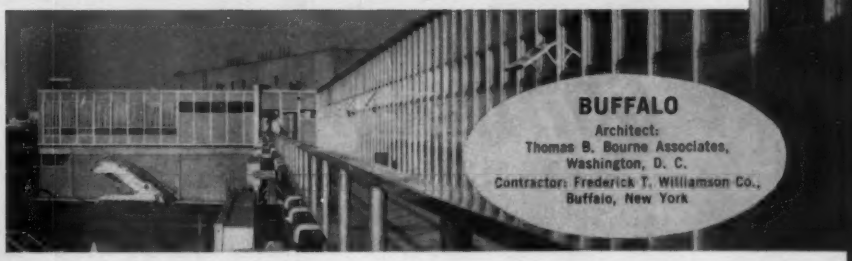

BUFFALO
Architect:
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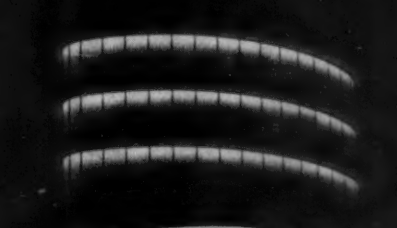

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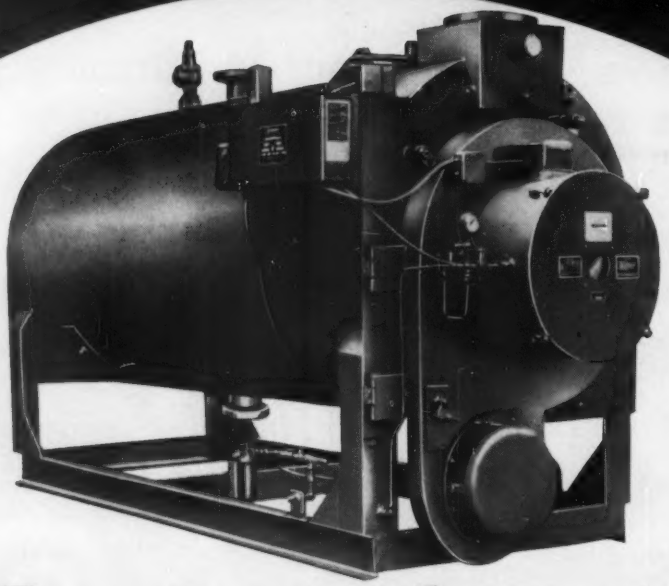

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July 10-14. University of California Extension; Short Course — "Technical Report Writing for Engineers and Scientists," UCLA, Los Angeles.

July 23-Aug. 4. Pennsylvania State University; Seminar on Structural Engineering Aspects of Atomic Shelters, Campus, University Park, Penn.

Aug. 16-18. Hydraulics Division, American Society of Civil Engineers; 10th Annual Hydraulics Conference, Univ. of Illinois, Urbana, Illinois.

Aug. 20-24. University of Michigan; International Conference on Structural Design of Asphalt Pavement, Campus, Ann Arbor, Michigan.

Aug. 23-25. American Institute of Electrical Engineers; Pacific Meeting, Hotel Utah, Salt Lake City.

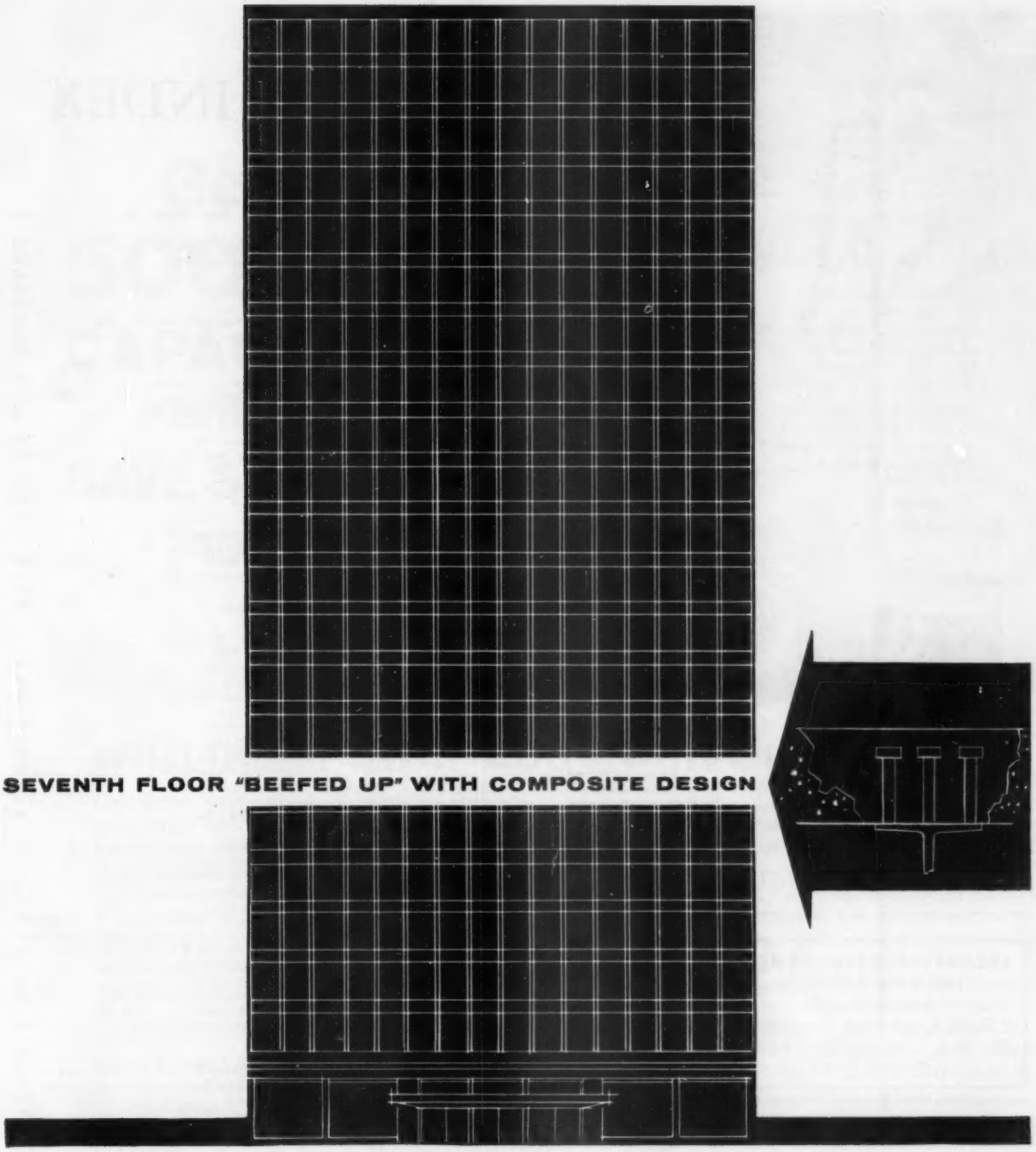
Aug. 24-25. University of Buffalo; Conference on Technical Manpower Utilization, University Campus, Buffalo, New York.

Aug. 28-Sept. 1. American Society of Mechanical Engineers; International Conference on Heat Transfer, University of Colorado, Boulder, Colorado.

Sept. 6. American Institute of Consulting Engineers; Monthly Luncheon Meeting, Engineers' Club, New York, New York.

Sept. 10-15. Pennsylvania State University; Seminar on Structural Aspects of Architectural Engineering, Campus, University Park, Pennsylvania.

Sept. 14-15. American Institute of Electrical Engineers and American Society of Mechanical Engineers; Engineering Management Conference, Hotel Roosevelt, New York, N. Y. ▲▲



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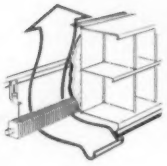

LET'S SAY you're designing a system where *perimeter heating* is indicated—possibly because of large windows and cold exposures—and you think of using Nesbitt Sill-line Radiation in wall-hung enclosures. But suppose it's an office, showroom, classroom, laboratory, studio, or one of many other places where there is a need as well for flexible *storage facilities*. Now you can fill both needs with one sensible installation!

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Publication 31-2 will bring you the full details.

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